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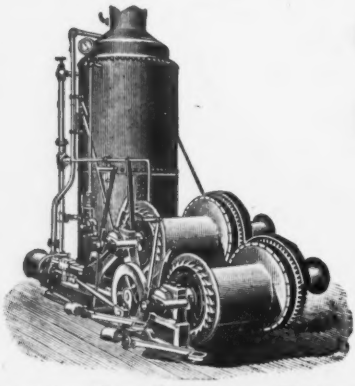

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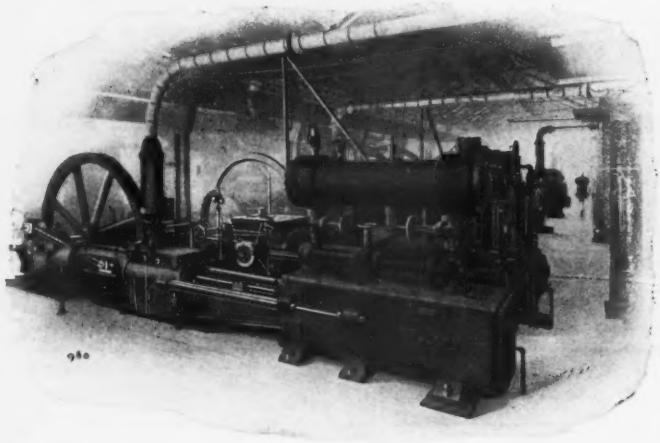

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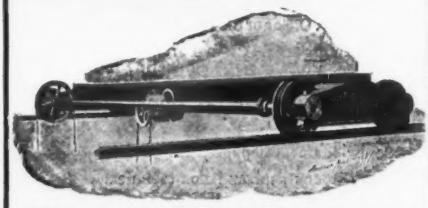

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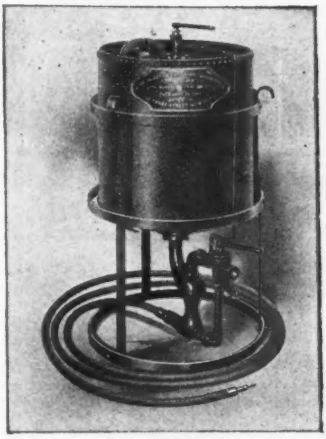

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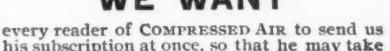

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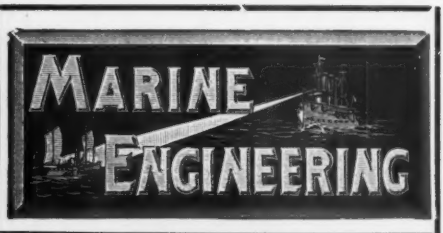

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VOL. X. JULY, 1905. NO. 5

Clarifying and Cooling the New York Subway.

The *Engineering News*, in a recent editorial on this subject, concludes with the following statement: "The problem of ventilation of the Subway, then, is not a problem of sanitation, but a problem of keeping the Subway temperature down to a reasonable limit." This logical view of the Subway trouble seems to have escaped the public and even the engineers who have been so free in their criticisms and suggestions. Tests are now going on by which "huge fans pump 15,000 cubic feet of air per minute upon perspiring travelers of the Subway," in an effort to do what one of the New York papers characterizes as "fanning the microbes out," when really the problem is one of temperature, and the only practical suggestion presented so far seems to be that of Mr. J. B. McDonald, the contractor, to inject cold water in the form of a fine spray in the tunnel over the centre of each track and over the roofs of the cars. The troubles in the Subway are not new. They are encountered usually in tunnels during the construction—notably in the case of the Simplon, where the temperature was so high that life could not exist until cold water was sprayed into the headings. In the case of the Simplon, the longest railway tunnel in the world, a practically perfect system of ventilation existed because of the fact that an auxiliary tunnel about 10 feet in diameter was driven within 50 feet of the main tunnel, and connecting passages were made near the headings, by means of which a constant volume of cool air was drawn in through the auxiliary tunnel and discharged near each heading, returning to the portal of the main tunnel, and in this way keeping up a constant current of outside air within the tunnel. Notwithstanding this ventilation, the high temperature was not reduced sufficiently to warrant the work being carried on, hence water, which has a high specific heat, was sprayed in the hot places, and the temperature was reduced to a practical point.

The *Engineering News* has taken pains to figure in an elaborate and thorough manner what the heating influences are in the Subway, but it must be plain to any casual observer that a large volume of air is boxed up at all points except at the stations, and that every influence in the tunnels is exerted to increase the temperature and nothing to decrease it. The brakes, the electric motors, human bodies, electric lights, and such like, all tend to raise the temperature of the air, and it is a well-known fact that if air is confined and its temperature increased, its relative humidity is reduced, so that we have a condition of things in the Subway where the air is being constantly dried. This gives it the oven-like or baked feeling so uncomfortable to the passengers. We are glad that the Chief Engineer, Mr. Rice, has given heed to Mr. McDonald's sug-

gestion, and that a test is to be made between two of the stations. Obviously the proper way to accomplish a result is to do it in the most economical manner, and while it is possible that there may be other means by which the air in the Subway may be clarified and cooled, yet the spraying system is the simplest, and it offers the most reasonable excuse for being tried, because the expense of installing it is light and it is quite possible that the spraying need only be done during the night time, when the traffic is light and when the temperature of the air might be reduced sufficiently to last all day. Water should not only exercise a cooling influence, but it should absorb noxious gases and particles of dust, and in washing down through the tracks it should clarify the broken stone, which serves now only to collect oil and dirt. A good deal depends upon the nozzles used, because it will not do to throw the water into the air in the shape of large globules. It must be a finely divided spray, and it is quite possible that the Subway engineers will adopt an atomizer consisting of a fine jet of compressed air forced at the point of the water nozzle, so that the water may be scattered into ærated particles and an added benefit received from the air used.

The Panama Canal and Mr. Wallace.

The unfortunate severance of relations between John F. Wallace and the Panama Canal is to be regretted. When it became known among engineers that Mr. Wallace had accepted the chief engineership of this great work there was a widespread feeling of confidence and a unanimous opinion expressed among engineers that the best man had been selected for the most difficult and important piece of construction undertaken during the century. Mr. Wallace had been trained in Western railway construction; of middle age, of ripe experience, a man of strong physique, deliberate, able, a masterful executive, a business engineer and a man of honor. Since his appointment he has devoted more than a year of his life to hard work on the Canal Zone, and his judgment in respect to conditions on the Canal is better to-day than that of any one else.

Every one who knows Mr. Wallace personally and all who know the facts in regard to the situation on the Canal will agree that Mr. Wallace has chafed under certain irregularities for which he was not responsible. His reputation was at stake; he knew that "governmental restrictions," political pull and other conditions beyond his power to prevent would ultimately lead to an extravagant cost, much delay in time, and a failure to perform this great work in a proper manner. He had been living on the Canal with his family and had been subject to dangers from fever, holding out because he loved the work, and because of his loyal nature doing this against his own private interest and against the wish of his family. An opportunity came to him to accept another position, not necessarily antagonistic to his work on the Canal. He asked for permission to come North and have a private interview with his superior officer, the Secretary of War. Permission was granted and he came to New York to lay before the Secretary frankly and fully the situation on the Canal, his own personal feelings about the matter, and to discuss, as any man might, what was best to be done under the circumstances. John F. Wallace had no intention when he came to New York to sever his relations with the Canal or to put the Government at a disadvantage. He was entitled to the private interview which he sought, but, instead of getting it, he was met by the Secretary, attended by his lawyer and a stenographer. Under such circumstances he was unable to talk frankly and freely; hence Secretary Taft, at the Manhattan

Hotel interview, got from Mr. Wallace only a part of the situation, not the whole of it. As the Secretary declined to give him a private interview the presumption is that he had prejudged the case and had already made up his mind what he should do. The action he took has placed Mr. Wallace in the position of either attacking the Government and his former associates on the Canal, or taking the alternative position of keeping silence, except to disclaim any intention of placing the Government at a disadvantage or of "dickering." To a man of Mr. Wallace's nature the situation must obviously be painful, yet no one who knows him well expects that he will ever strike back and involve others in order to justify himself. He is capable of standing an overload of abuse rather than to defend himself at the expense of others. Time will justify him in the position he has taken. A character which has been built up to so great a height cannot be thrown down in a day even by the guns of the United States Government.

An Influence for Progress.

The development of compressed air as a means of power transmission has been dependent on those companies which have manufactured the machinery and devices utilizing this power. No better illustration of this point can be found than in the history of the air brake and the Westinghouse Air Brake Company. There are other companies manufacting air brakes, but the Westinghouse interests have been particularly identified with the progress made and the Westinghouse engineers have been specially prominent in developing the air brake to its present state of perfection.

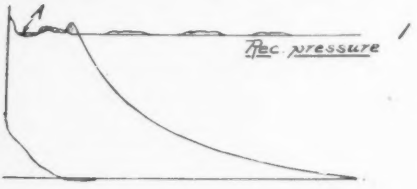
In perfecting the air compressor and the rock drill, the Ingersoll-Sergeant Drill Company and the Rand Drill Company have been important factors. The merger of these two companies in the Ingersoll-Rand Company has, therefore, a definite bearing on the future of compressed air. It means a union of valuable patents which will result in better machinery. It also means a unity of effort on the part of the engineering experts who have brought this machinery to its present stage. With this unity of effort should come greater and more rapid strides in improving the existing methods.

The Hammer Drill.

One of the needs of the present day is a one-man machine drill, light and easy of transportation, fast and simple in operation. To meet this need several inventions have been placed on the market. This issue of COMPRESSED AIR contains a description of one of these so-called "hammer drills," which seems to have proven its efficiency in this field. Its success will mark a distinct advance in the work of rock excavation, either below ground or in the open-cut. The common form of the rock drill has its place in rock excavation. There is, however, work which even the lightest form of the rock drill cannot do successfully and which has hitherto required hand labor. A visitor to the International Railway Congress had with him a sample of rock which he had been drilling by hand at the rate of 8 inches per hour. A trial with the small "hammer drill" resulted in a hole 3 inches deep in one minute. The difference is, however, not greater than has been shown in many other instances when hand drilling and machine drilling have been compared. The old question of hand drilling *vs.* machine drilling has long ago been decided in favor of the power drill. This particular phase of the question is immediately answered as soon as the need for and the efficiency of the "hammer drill" is proven.

Study of a Riedler Air Compressor.

The general type of machine which the writer is to discuss is shown in Figure 1. As will be seen from the illustration, the machine has only one cylinder, the head end serving for the steam end, and the crank end the air compressor. There are two steam valves, *B* and *C*, of the Corliss type, which allow a very good control of the steam. The valve *B* regulates the cut-off and the valve *C* the release.



The compressor end of the machine upon which we will devote our attention has a mechanically-operated oscillating inlet valve, *D*, this valve being so constructed that a connection is made between the cylinder and clearance space *E* by means of the by-pass *F*, at the end of the compression stroke, the object being to equalize the pressure on both sides of the valve, thereby permitting the same to move more freely. The discharge valve *G* is so constructed that it opens automatically and is closed mechanically by the spring *P*.

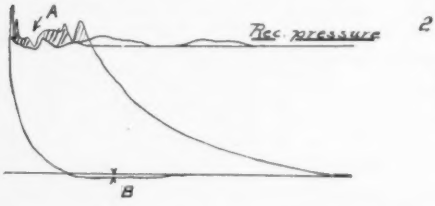
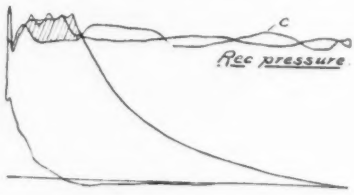
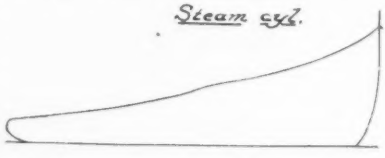


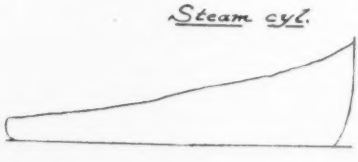
Figure 2 shows the construction of this valve. *A* is the body and *e* the valve seat. The operation of the valve is as follows: After the piston has finished its suction stroke and is about to begin the compression, the pressure of the air in the receiver on the surface *B* holds the valve on its seat. As the pressure in the cylinder increases the pressure on the surface *C* also increases, thus decreasing the pressure which holds the valve on its seat. When the pressure in the cylinder is equal to that in the receiver there is no unbalanced air pressure acting on the valve to keep it closed. In other words, the pressure exerted by the air in the receiver on the surface *B* is exactly balanced by the pressure exerted by the air



in the cylinder on the surface *C*. The resistance which the valve itself offers to opening must be first overcome before the valve opens; that is, there must be a slight excess of pressure in the cylinder before the valve can open. This excess of pressure acts on the surface *C*.



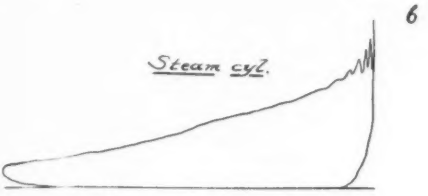
After most of the air has been discharged and the piston is very near the end of its stroke, the spring *P*, moving on a bolt screwed into the piston, as shown in Figure 1, comes in contact with the valve on the surface *g*, closing it mechanically. The valve is held on its seat by this spring until the pressure in the cylinder is lower than that in the receiver, after which it remains closed (due



to the pressure in the receiver) until the pressure in the cylinder is again sufficient to overcome that in the receiver as well as the resistance of the valve itself.

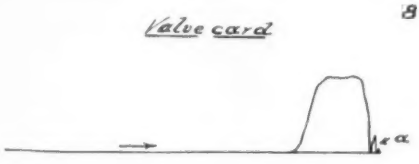
Referring again to Figure 1, it will be seen that the compressed air, after passing through the discharge valve, is circu-

lated around the jacket of the steam end of the cylinder, thereby lessening the condensation of steam on the inside cylinder walls.



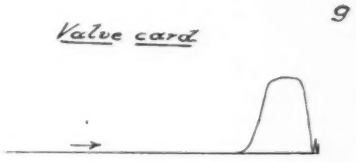
The general working of the machine having been explained, we will now turn our attention to a series of cards taken under various conditions.

Series I.—Pressure in the receiver constant, rotative speed gradually increasing. Cards 1, 2 and 3 are those taken from the air end; 4, 5 and 6 those from the steam end, and 7, 8 and 9 the valve cards.

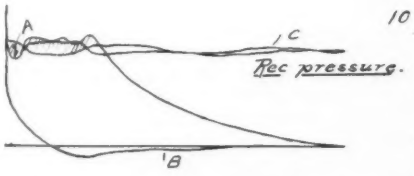


Taking the cards 1, 2 and 3, from the air end, we note the sudden drop in pressure at *A*. This is caused by the expansion of the air in the chamber *E* after the cylinder has been connected to this space by means of the by-pass *F* (see Figure 1). The fluctuation in the pressure in the receiver is due to the single action of the piston. It will be seen that the suction valve is opened somewhat too late in cases 2 and 3. This is due in part to the construction of the compressor, it being more efficient under the conditions shown by card 1, namely, 5 atmospheres pressure in the receiver and 60 revolutions per minute.

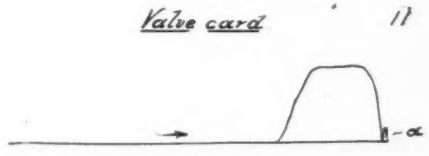
Let us now consider the action of the discharge valve with increasing speeds. At 60 revolutions per minute (see card 7) the action of the discharge valve seems to be fairly good, although the closing of the same by the spring has a tendency



to cause the valve to vibrate; this can be seen by referring to the card at *a*. This tendency to vibrate becomes more marked with an increased speed, as can be seen on cards 8 and 9.

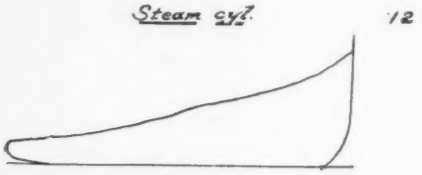


Further, the resistance which the valve offers to opening increases with the speed, necessitating an increase of pressure in the cylinder (assuming a constant pressure in the receiver, as was the case for cards 7, 8 and 9) before the valve opens; this means that the valve must open later, as is seen to be the case by reference to cards 7, 8 and 9. Further, the valve is always closed by the spring at the same period of the stroke, which means that,



in order to maintain the same velocity of the air through the discharge valve when the speed is increased (naturally within certain limits), the average lift of the valve must be increased. In increasing the speed from 60 to 93 revolutions per minute a slight increase in the lift is noticeable; on the other hand, an increase in speed from 93 to 120 accompanied by no increased lift. Thus the valve opens

later and more rapidly with increased speeds and is closed at the same period of the stroke, which means a marked increase in the velocity of the air through the valve. This limits the use of this type of machine to cases where the variation in pressure and speed is slight. In other words, this type of machine must be designed for a certain speed and pressure, a deviation from which may cause a considerable loss in efficiency. This seems to the writer to be one of the defects of this type of valve for this class of machines, and he favors the use of

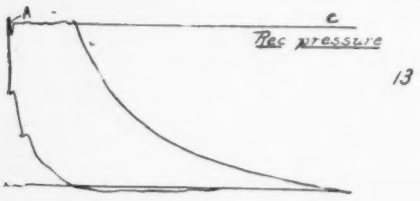


some such valve as described in his article, "A Study of Air Compressor Valves" (see COMPRESSED AIR for November 19, 1904).

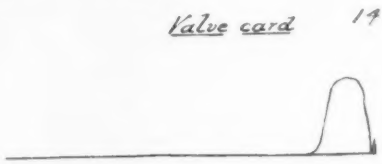
We now come to the second series of tests in which the conditions were somewhat different.

Series II.—Revolutions per minute constant, but pressure in the receiver varied.

Cards 10, 11 and 12 were taken at 134 revolutions per minute and with an absolute pressure in the receiver of 3.5 atmospheres; cards 13 and 14 at about the same speed, viz., 130 revolutions per minute and 6 atmospheres pressure in the receiver.



Referring to card 10 it will be seen that the deviation of the suction line from the atmospheric line is more marked than in the previous cases, showing that the machine does not work as well under these conditions. The same effect is noticeable at *A* as previously—the pressure in the receiver becomes more constant with the increased speeds. Card 13 shows less variation at *B* than card 10; also the pressure in the receiver is practically constant. It would seem that the machine was designed for a pressure of between 5 and 6 atmospheres in the receiver, as at this pressure the best cards are obtained. Cards 11 and 14 show the same vibration at a due to this method of closing the discharge valve.



In conclusion it may be said that this method of mechanically closing the discharge valve is by no means efficient and shows defects which should not be noticeable in this form of machine.

ARTHUR P. HALL.

Compressed Air Locomotives for Mine Haulage.*

The problem of getting coal from the working face to the surface in the most economical way is one of the most serious which the mine manager has to solve. Compressed air locomotives are one of the means of solving this problem. That they have many advantages for work of this character is obvious. They are fireless, smokeless and odorless—three very desirable qualities underground, where fire is one of the greatest dangers and pure air a necessity.

The only objection to this system of haulage is the cost of buying, installing and operating air motors, and making the entries or gangways large enough for them to pass through, which is generally supposed to be high. An installation involves not only locomotives, but a boiler plant, a high-pressure air compressor, and a pipe line that will convey the high-pressure air safely and without undue loss or leakage to charging stations so located that the locomotives can cover the desired territory without danger of getting out of air. All of these details have been worked out, and are in every-day service in some of the largest coal,

*By C. B. Hodges in the *Mining Magazine*.

iron, copper, lead and gold mines in the world. Compressed air locomotives have been built of all shapes and sizes—in weight from 8,500 pounds to 42,000 pounds; for gauges of 18 inches to 56½ inches; in width from 39 inches to 9 feet; in height from 3 feet up to 10. High-pressure compressors are also built to suit all conditions. The most common type in the coal fields is the three-stage straight-line, with a single steam cylinder. Where higher economy is desired, the same machine may be equipped with compound steam cylinders; or the duplex or cross-compound type of steam engine, with either Meyer or Corliss valve gear, may be combined with four-stage air cylinders; or the compressor may be operated by electricity or water power. All of these designs have been worked out, and most of them are in everyday service.

The pipe line is no less important than the compressor and locomotive. It has received just as much attention, and there are miles of pipe lines from 2 to 6 inches in diameter carrying air at 1,000 pounds pressure that do not lose by leakage 1 per cent. of the air delivered to them; and on account of the care exercised in the manufacture, inspection and installation of these pipe lines, failures are less frequent than with steam and air lines for lower pressures, and have never resulted in loss of life or serious injury. The charging station is simply a tee in the pipe line, together with a stop and bleeder valve and a flexible metallic coupling. With the usual designs, the locomotive does not stand more than a minute or two at the charging station to receive a charge of air; and as the best compressed air locomotive will travel from 3,000 to 10,000 feet with one charge, the time required for charging is not worth considering under the usual conditions of mine haulage.

Compressed air locomotives were first built in 1890. To-day they are being built at the rate of 40 to 50 per year, and there are several hundred in constant use. They have passed through the experimental stage, and the results to be obtained, and the cost of obtaining them, can be predicted with as much certainty as with any other class of machinery.

When the superintendent of one of the largest mines in the United States purchased his first compressed air locomotive, he felt the moving of 2,000 tons daily an average distance of about 1,200 feet would probably cost him more money than his existing equipment of steam locomotives, but that the peace of mind due to reduced risk of fire justified the additional expenditure. The compressed air locomotive was much heavier and more powerful than the steam locomotives previously employed. When installed, it did in eight hours work which required twenty-four with the less powerful steam locomotives. Cheap fuel burned under economical stationary boilers replaced expensive fuel burned under the rather wasteful boilers of small steam locomotives. He put in larger cars and improved the dumping arrangements; the final result was the luxury of peace of mind and a saving of $20 a day.

Special conditions in the above instance gave the compressed air locomotive special advantages. The steam locomotive is in most cases cheaper to buy, and, if we include the interest on the investment, cheaper to operate. Air haulage is so simple, safe, easily operated and so seldom heard from at the head office after its installation, that it seems as though it must be expensive. In some cases the first cost is higher than with other forms of haulage, though, as compared with electric locomotives, the difference is quite frequently more apparent than real, because, in making the initial installation with air a sufficient quantity of pipe or large steel tanks must be purchased, in order to provide an adequate stationary storage for the compressor to pump into while the locomotives are in motion, and ready to deliver instantaneously to the locomotive a quantity of compressed air sufficient for the next trip. The expenditure for additional pipe to extend the system is comparatively slight, since much smaller pipe can be used and since the locomotives travel from 3,000 to 5,000 feet beyond the last charging station; whereas with electricity exactly the reverse is the case, as the wires must be in place on every gangway before the locomotives can be used. When the locomotives are operating close to the generator, the wires may be not only short, but small and light; but as the distance increases the wires must not only be longer, but also heavier. For a given drop in voltage it requires four times as much copper to transmit a given amount of power twice the distance, nine times as much copper

for three times the distance. There are methods of overcoming this difficulty with high-voltage alternating currents and rotary transformers, but they all cost money, and a careful estimate of the total cost of the haulage under both systems when they have been extended to the limits of the field should be substituted for the easier but less accurate method of comparing bids for doing a specified amount of work under existing conditions.

The cost of operating compressed air locomotives, if they are properly constructed, is generally less than with any other form of haulage. Mule-drivers, boys and laborers are in a short time transformed into successful runners of compressed air locomotives. The necessary repairs can be made by the mine mechanics, the renewing or returning of the tires being in most cases 75 per cent. of the total cost of all repairs for the entire plant. This is only true when the work is properlv done in the first place.

Pipe, to be durable, tight and safe under 1,000 pounds pressure, must be heavy enough and made of good material; special socket flanges, fittings and valves are required.

Tanks to contain air at a pressure of 800 or 1,000 pounds must be made from good steel and the workmanship must be of the highest order; drilled or reamed holes for all rivets; rivets of large diameter and plenty of them, to correspond with the thick plate necessary for such pressures; a powerful hydraulic riveter, capable of causing such rivets to fill the holes and at the same time bring the heavy sheets into close contact; bending rolls and a flanging press capable of handling plate up to 1¼ inches thick; and last, but by no means least, a rigid inspection of the finished tank, which will not allow it to leave the shop until it will stand for hours under a hydraulic test pressure of 25 or 30 per cent. in excess of the working pressure without losing a single drop. A regulating valve on the locomotive that will regulate and maintain a constant pressure at the throttle valve, as the locomotive will either slip and waste air, or else be short of power, if this essential part does not perform its work in a proper manner. Compressor, charging stations, valves and fittings all made specially for this service.

These are a few of the features of a successful compressed air haulage installation. Every detail has been worked out successfully and can be seen in operation. But the heavy repair accounts and other troubles which some mine operators have had to stand after entrusting such work to locomotive and compressor builders who only take an occasional contract for equipment of this character, is a strong argument in favor of placing the work in the hands of those who are making and have made a regular business of it.

Simplicity in design, construction and operation is, or should be, the aim of every builder of mine equipment, and this is more fully emphasized in the air locomotive as generally introduced to-day than maintains with any other system of mechanical haulage for mine service.

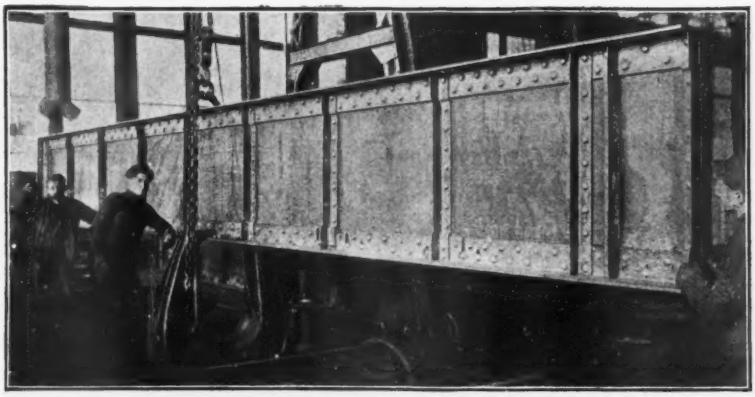
The only other item of expense is the steam or other power to operate the compressor.

The advocates of electric locomotives claim that their efficiency is two or three times as high; and so it is, occasionally, when the locomotive, generator and engine are all working at their most economical load. But, unfortunately for them, this condition does not exist for any considerable length of time. Go into the powerhouse of any mine where electric locomotives are used and watch the pointer on the ammeter. Much of the time the engine will be seen puffing steam out of the exhaust pipe without indicating that it is performing useful service. With compressed air, on the other hand, every revolution of the compressor counts. The air goes into the pipe line and does not get out until it does useful work in the cylinders of the locomotive. For brief periods throughout the day the efficiency of the electric system is much higher than that of the compressed air, but this is not true for an all-day average. The electric fuel bill will generally be either a little higher or a little lower than with compressed air haulage—higher when the demands for power fluctuate within relatively wide limits and lower when the demand is more uniform.

While only of recent introduction, and with but few friends in the past to exploit it, compressed air is to-day widely recognized as one of the most useful, simple and reliable agents for mechanical haulage for operations both above and below the earth's surface.

Modern Production and Application of Compressed Air.*

Looking through any large manufacturing plant to-day one is astonished at the number of pneumatic appliances in use. The slow, laboring thud of the hand hammer has given way to the buzz of the pneumatic tool, and noting the ease with which these tools are handled the modern manufacturing establishment presents a very different appearance to the old-fashioned shop. The general tone of the modern shop is businesslike and the application of compressed air to various pneumatic appliances has revolutionized many manufacturing industries. The gain has been universal—to the laborer, by relieving the drudgery; to the producer, by lowering the cost of production; to the consumer, by supplying him with a better article at a lower cost.



STATIONARY PNEUMATIC YOKE RIVETER.

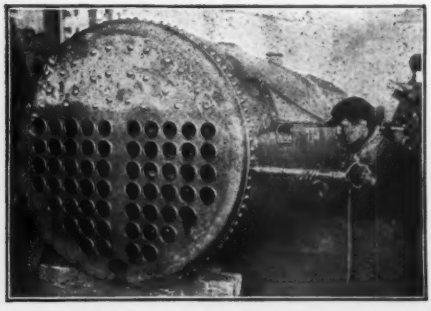
At the present time there is no branch of engineering receiving more attention than compressed air (and its applications) merited by its steady development and great possibilities. The value of compressed air as a motive power is directly due to its transmission qualities and its comfort to the operator. It has given a flexibility to the manufacturing plant hitherto impossible, for, the mains once laid and convenient openings provided, any tool may be used at any part of the shop. The value of this is at once apparent, because whatever was formerly done by hand or moved to the stationary tool, is accomplished on the spot in far less time and in a better manner by the pneumatic tool. Where the use of steam was prohibitive on account of the condensation difficulties, the discomfort to the operator, and the impossibility of designing tools for efficient operation, compressed air is being used with most gratifying results. Its only rival from the standpoints of transmission, adaptability, cost of installation and maintenance is electricity, but in many appliances the air tools have undisputed preference.

Compressed air in mining and quarrying operations has long been appreciated, but only of later years has the development of numerous pneumatic appliances brought it into the greater industrial world. This development has been slow, but in view of the wide interest now being manifested, there is every reason to anticipate that the already high efficiency of the tools will be advanced and many more appliances designed with a view toward widening the sphere of usefulness of this valuable power.

No modern foundry, structural, boiler or machine shop is complete without its complement of air tools, and in these

* From Canadian *Machinery*. Illustrations shown through the courtesy of the Canadian General Electric Co., Ltd.

branches of industry compressed air has made its greatest strides. The illustrations in this article were taken in the above departments of the Davenport Works of the Canada Foundry Company,



PNEUMATIC HAMMER RIVETING.

Limited, Toronto, and the percentages of saving shown are the averages of a number of operations.

Referring especially to the applications illustrated, the pneumatic hammer stands first as the most serviceable tool. For chipping castings and boiler plates it shows a saving over hand chipping of 70 per cent. and in its most important field, the boiler shop, the results are almost incredible. The following table will give a fair idea of what this tool has accomplished:

Class of Work	Per cent. of cost saved.
Riveting	68
Beading	76
Chipping flue sheet	85
Cutting off stay-bolt heads	60
Cutting out broken fire-box stays	72

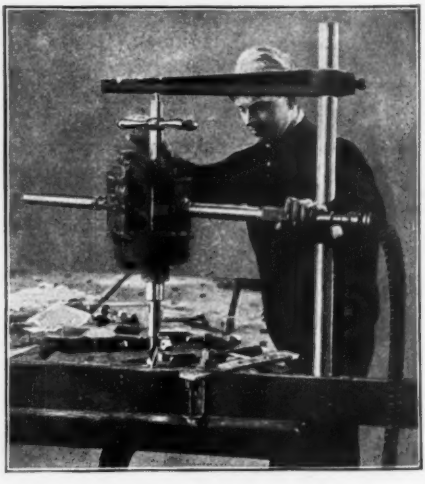
Next in importance in the boiler shop is the pneumatic drill, which for general work shows a saving of 75 per cent. to 80 per cent. In addition to these tools this department of the Canada Foundry Company is equipped with a hydro-pneumatic accumulator, supplying power to a large flanging press, punches, including manhole and handhole punches, shears and a bull riveter.

The pneumatic drill and reamer, as shown in the illustration, is invaluable for such work as cannot be conveniently placed under the drill press. The breast drill shows over 90 per cent. saving in cost and time over the old ratchet hand drill, and the following results are fair averages for the post drill:

Class of Work.	Per cent. of cost saved.
General machine shop work	78
General boiler shop work	76
Drilling for stays	52
Tapping for stays	66
Reaming crown sheet	72
Facing steam pipes	77

PNEUMATIC CHIPPING HAMMER.

The illustration from the structural shop shows one form of stationary pneumatic yoke riveter. Several portable riveters are also used and each type has its special advantages. For heavy work the portable



PNEUMATIC DRILL AND REAMER.

type is unquestionably quicker. The saving with these tools over hand work is about 66 per cent.

There is a still more efficient hydro-pneumatic riveter not as yet in general use, in which the vertical adjustment is controlled by a three-way valve, and the hammer stroke by a foot valve.

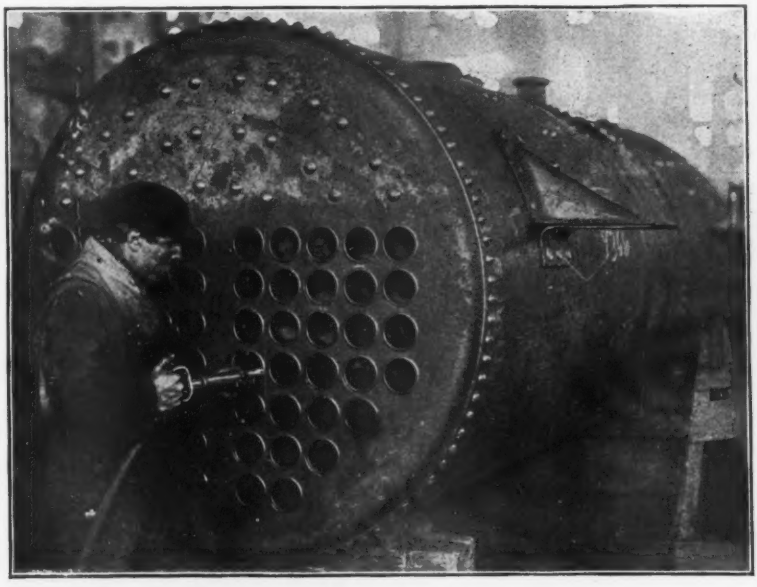
Although compressed air is best known in connection with the mining, quarrying and mental working industries, there are hundreds of other applications showing large savings and no less important in their particular duties. Amongst these are the following pneumatic appliances:

Hoists, accumulators, locomotives, brakes, jacks, cranes, ejectors, elevators, sand blast apparatus, painting apparatus, dump cars, sanders for locomotives, bell ringing apparatus, flue cleaners, glass and metal blowers, stone cutters, copying and straightening presses, street sweepers, block signals, canal locks operation, etc., etc. In addition to these, the application of compressed air to many stationary engines, hoisting engines, pumps, etc., has obviated the difficulty of long steam transmission, while its direct application for the purpose of cleaning electrical machinery, car cushions, carpets, etc., the refining of asphalt, the agitation of syrups in the sugar refineries and slag in the cement works, the aerating of liquids, and for the raising of water from deep wells, is showing highly satisfactory results.

The following figures showing percentages of saving with miscellaneous pneumatic appliances, may be interesting:

Tool.	Class of Work.	Per cent. of cost saved.
Paint sprayer	Painting box cars	69
Paint sprayer	Painting car trucks	88
Paint burner	On passenger cars	68
Sand blast	Cleaning tanks	92
Air jet	Cleaning cushions	51
Driving box press	Pressing brushes	69
Stay bolt nippers	Cutting off stays	85

The application of the air brake to street cars is at present receiving particular at-



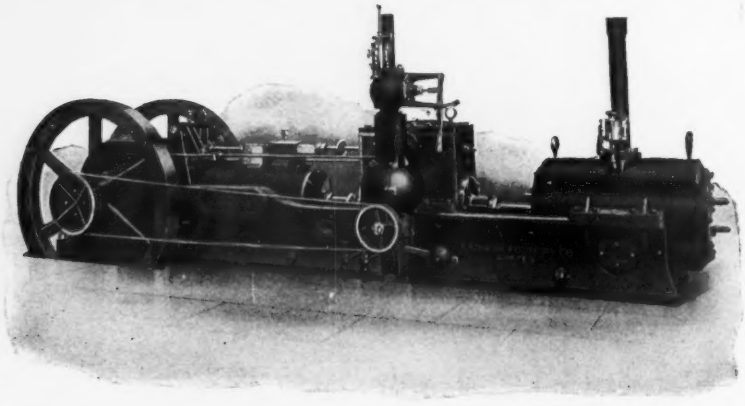
PNEUMATIC HAMMER BEADING BOILER FLUES.

tention. The numerous accidents, due in part to the sluggishness of the hand brake, are bringing home to the street railway

PNEUMATIC METAL BLOWER.

railway service, where the suburban lines requiring numerous quick stoppages were most benefited by the advent of the air brake, in street service, where the stops are much more frequent, the gain is more apparent. There are two methods of generating compressed air for this service, both of which have been successfully carried out. One is by having separate generating units under each car, and the other by having generating units distributed at long intervals throughout the system from which storage tanks under the cars are filled. The Canada Foundry Company recently equipped a number of Montreal street cars in the former manner, and the result has been eminently satisfactory.

Referring briefly to the modern production of compressed air, the Canada Foundry Company has lately developed a new compressor, a cut of which is printed here. This machine has several new features and represents a marked advancement in this class of machinery. It is entirely self-contained on a strongly ribbed box frame. A central crank and connecting rod are used and the crank end is completely

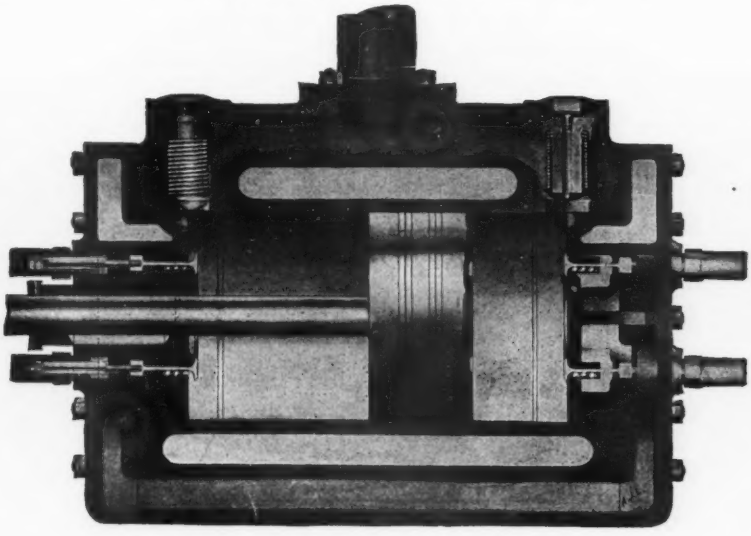


STRAIGHT LINE AIR COMPRESSOR, NO. 762, TYPE I. RECENTLY DEVELOPED BY THE CANADA FOUNDRY COMPANY.

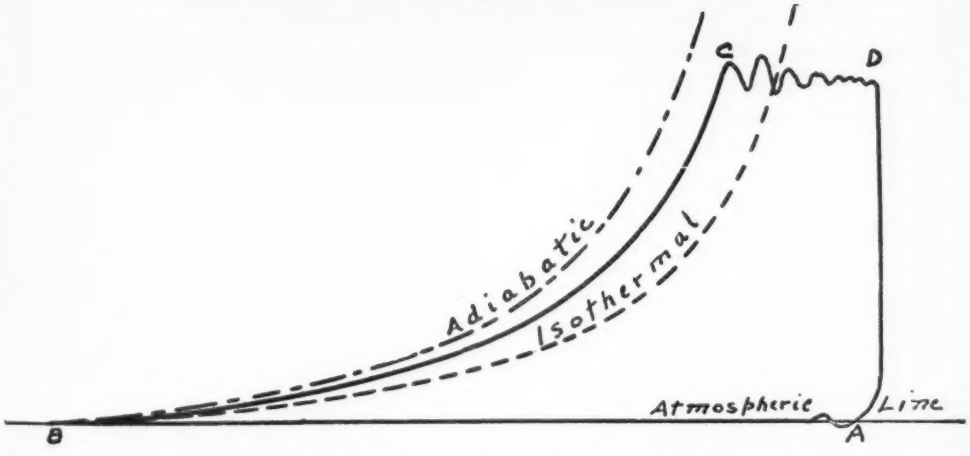
companies the necessity of a more efficient device for this important duty. That the air brake, so indispensable to the larger railways, will fill this need, has been proved beyond experiment. Many long distance trolley lines and some street lines are already equipped, and just as in steam

enclosed. Provision is made for easy access to adjustable parts. The crosshead moves in a bored guide and has adjustable shoes at top and bottom. A large oil reservoir is situated in the main frame at the crank end and a disc mounted on this crank shaft dipping in this reservoir con-

veys oil up to a scraper resting on the disc rim, which guides the oil to a smaller reservoir. At slowest speed sufficient oil is raised to this "head" to supply main bearings, crank pin, eccentrics, crosshead pin and guides, with continuous streams of oil. After passing over the wearing surfaces the oil flows back by gravity to the main reservoir and is used over and over again. The enclosed end is specially constructed with a view to preventing any splashing or leakage of oil.



AIR CYLINDER SECTION.



INDICATOR CARD FROM 12 X 12 X 18, TYPE I COMPRESSOR. BUILT BY THE CANADA FOUNDRY COMPANY.

The steam cylinder is covered with heat retaining material and the main valve is fitted with Meyer adjustable cut-off plates.

A section view of the air cylinder is re-

produced here and an air indicator card from one of the machines recently built. The section view of the cylinder shows that special attention has been given to clearance and water jacketing. The outlet valves are the ordinary poppet type except that when open the bronze guide supports the valve down to the bottom. The inlet valves are weldless, annular rings of steel mounted on steel balls. There is one valve in each head and they are prevented from being drawn into the cylinder by solid lugs on valves and heads. Light springs are used to close them at the end of the stroke. The high volumetric efficiency obtained with these valves is demonstrated by the indicator card shown. The indicator card also shows effective cooling and ample outlet area. The same design has been carried out in the duplex compound types, and this company is prepared to supply self-contained, self-oiling compressors of this kind for all duties, with either plain slide or Corliss steam valves.

The aim of the manufacturers has been to produce a compressor second to none, and the result is a highly efficient, simple, self-oiling, self-contained machine, not requiring an expensive foundation nor high erection charges.

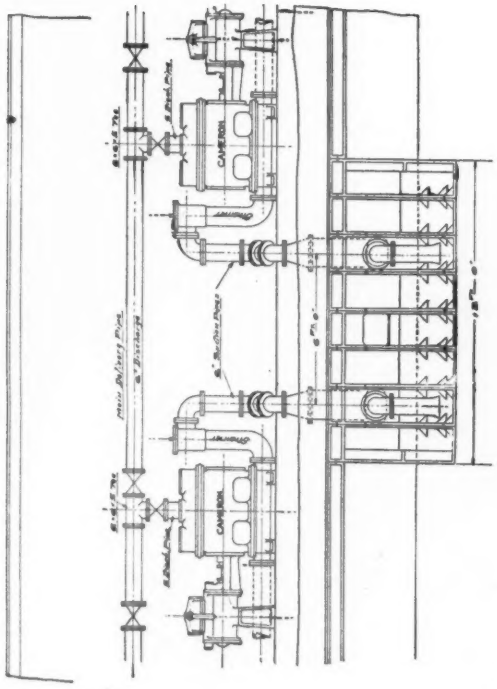
Drainage of the Interborough Rapid Transit Railroad under the Harlem River.

Probably one of the most important engineering problems encountered in the building of the New York Rapid Transit Subway was the construction of the two tunnels, or tubes, under the Harlem River. These two tubes, through which the subway trains are to run regularly from the Lexington avenue subway, continuing to The Bronx subway, were constructed on an entirely new engineering principle, having been built of concrete above ground and then sunk to the bottom of the river, instead of having been forced through the mud under the river bottom, as has been done in such work heretofore. These twin tubes are 641 feet in length and are 16 feet in diameter, the top of the tunnel being 20 feet below the low-water mark. Before the tubes were put in place, the engineering department of the subway contractors devised a system for the drainage of the seepage, or the water percolating through the walls of the tubes, and also in case of emergency arising from a sudden inrush of water in the event of the breaking of a water main. The drainage and pumping system adopted, and the precautions taken to meet the possible conditions, are graphically described and explained in the accompanying illustration.

Illustration Figure 1 shows a sectional view of the tunnel, looking southwest and showing the arrangement of the pumps, which are in position in both of the tubes at the junction of the subway and mouth of the tunnel at Harlem River. Special pumps were adopted for this service, having been especially designed and built by The A. S. Cameron Steam Pump Works, having their general offices and works at the foot of East Twenty-third street, New York. A longitudinal arrangement of the piping and connections for the pumps is shown on the right hand side of this illustration.

Figures 2 and 3 are reproductions of photographic views taken in the tubes, and show the inside constructions of the tunnel, with pumps in position. In the first of these two views a portion of the end of the concrete archway is shown, and it is at this point where the two tubes are joined and the double tracks continue in one tunnel.

Figure 2 shows two of the pumps in position on concrete foundations, with the arrangement of piping and connections. Four of these pumps were installed, being of the size 12 by 12 by 18, and are of the simplex single cylinder pattern, having the Cameron regular pattern steam end, which is equally efficient with compressed air or with steam, the motive power for these pumps being compressed air. Each of these pumps have their separate air lines to the compressor plant, which is situated over three-quarters of a mile away, above ground. The pumps are controlled automatically by separate floats located in the tunnel. The automatic float for one of the pumps is shown in the illustration along the wall on the left hand side. The other pump, in the distance, has its automatic float nearer the floor and attached to the pump. An air reservoir 16 inches in diameter by 36 inches long is arranged in the air pipe line at the throttle of each pump. The suction piping is also shown extending into the pump, the top of which is protected by iron gratings.


CAMERON
CAMERON

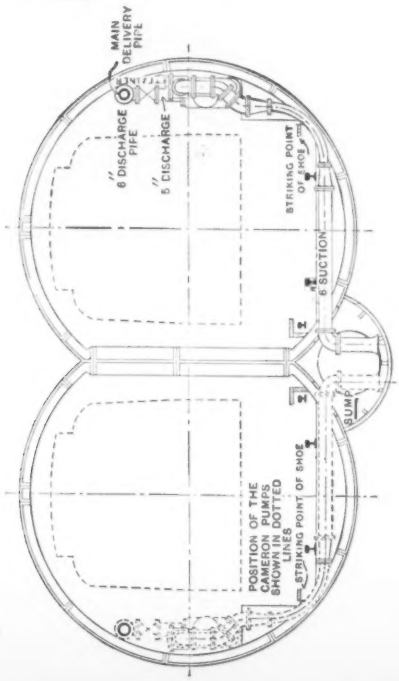

MAIN DELIVERY PIPE
6" DISCHARGE PIPE
5" DISCHARGE
STRIKING POINT OF SHOE
6" SUCTION
SUMP
POSITION OF THE CAMERON PUMPS SHOWN IN DOTTED LINES
STRIKING POINT OF SHOE

FIGURE I.

Figure 3 defines more clearly the outside construction of the pumps, the distinctive feature of which is the construction of the water cylinders, which necessarily are very compact, owing to the limited space allotted to them, the extreme width being only 19 inches; nevertheless they have ample water valve area. The water valves are set in removable valve decks, allowing them to be easily removed with minimum time cost. The suction valves are placed under the water cylinder, and the discharge valves are shown above the water cylinder.

Each of the pumps are separately and independently connected and are also designed with the suction and delivery flanges looking fore and aft, permitting the arrangement of the suction pipes as shown, with the pipes running under the "air end," and the foot under the air end made in two parts, straddling the 6-inch suction pipe, permitting the piping to be readily removed. Each of these pumps is capable of delivering 600 gallons of water per minute while running at a normal speed, with an air pressure at the throttle of about 70 pounds per square inch, and a total lift of 70 feet. The capacity could be increased to 1,000 gallons per minute in case of emergency.

FIGURE 2.

The valve chambers are so constructed as to permit of easy access for inspection and necessary repairs. The water piston rods are of composition, and owing to the liability of the water being dirty and very gritty, the water cylinders are constructed with removable composition metal bush-

ings. The suction pipes of the pumps are supplied with Cameron strainers of the gooseneck pattern to keep out the dirt and rubbish and to insure the priming of the pumps by keeping the suction chambers filled with water; thus the cylinders will be flooded with water at all times, permitting the pumps to be started up at any time by the automatic floats.

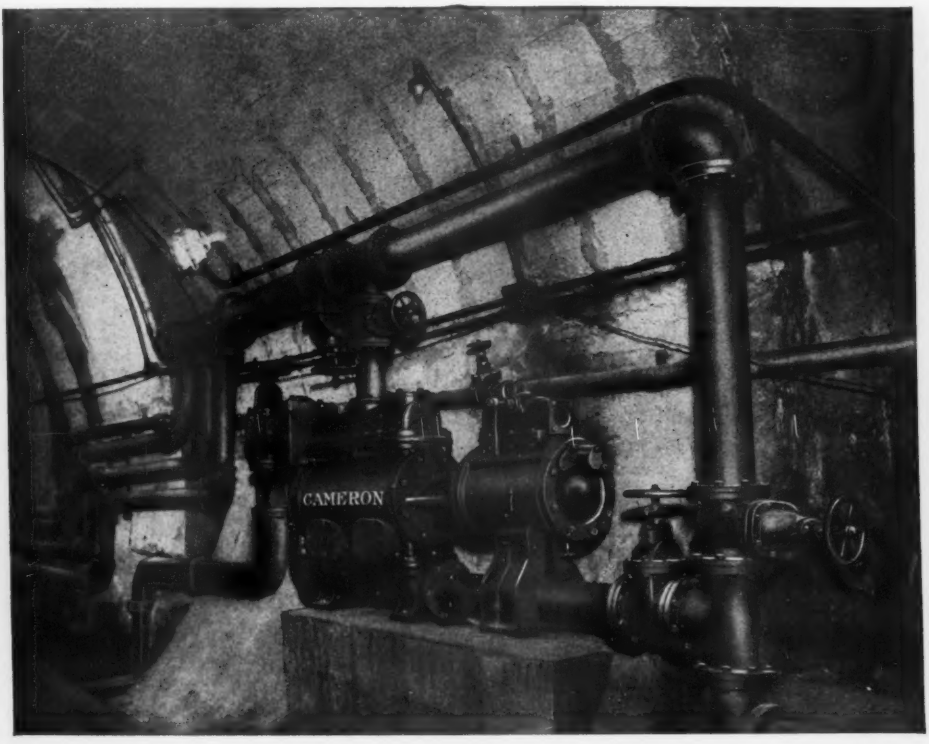


FIGURE 3.

In the event of the water rising, each of the pumps would immediately start pumping as soon as the water would reach the float level.

These pumps have already been severely tested, owing to the discovery of water in the tunnel some time ago, when temporary piping and connections were hurriedly made and the pumps were pressed into use at short notice, being in operation day and night, and performing good service; the inflow of water being entirely taken care of and causing but a slight interruption in the completion of the work.

Another meritorious feature of these pumps, as well as in all types of Cameron pumps, is found in the design and construction of their operating mechanism, which has but few working parts, and no outside valve gear or rods to become broken or to get out of alignment.

Floating timbers and debris, which are oftentimes the cause of damage to submerged pumps can do no harm to Cameron pumps, as the working parts are not exposed. Often a Cameron pump has been submerged under water for weeks and has kept right on pumping to the limit of its capacity until it has cleared the shaft or mine.

Gas Compressing Plant at Hundred, W. Va.

The United States Steel Corporation at its plants near Pittsburg consumes about 65,000,000 cubic feet of gas per day, which comes through hundreds of miles of pipe from the natural gas wells of Western Pennsylvania and West Virginia. When the wells were first opened the natural pressure of the well was sufficient to produce the flow through the pipe, but as the gas was exhausted from the wells the pressure fell, and it became necessary to install compressors to deliver it.

A typical compressing outfit for this purpose is located at Hundred, W. Va. This plant consists of two compressors supplied with steam from six boilers. These are horizontal water-tube Cahalls of 250 horse-power capacity, set in batteries of two. Each battery is provided with a self-supporting steel stack 54 inches in diameter and 60 feet high. The boilers burn natural gas, each being equipped with five burners of special design, and five steam jets in each boiler are used to facilitate the proper mixing of the gas and air. Combustion under these conditions is said to be as near perfect as possible.

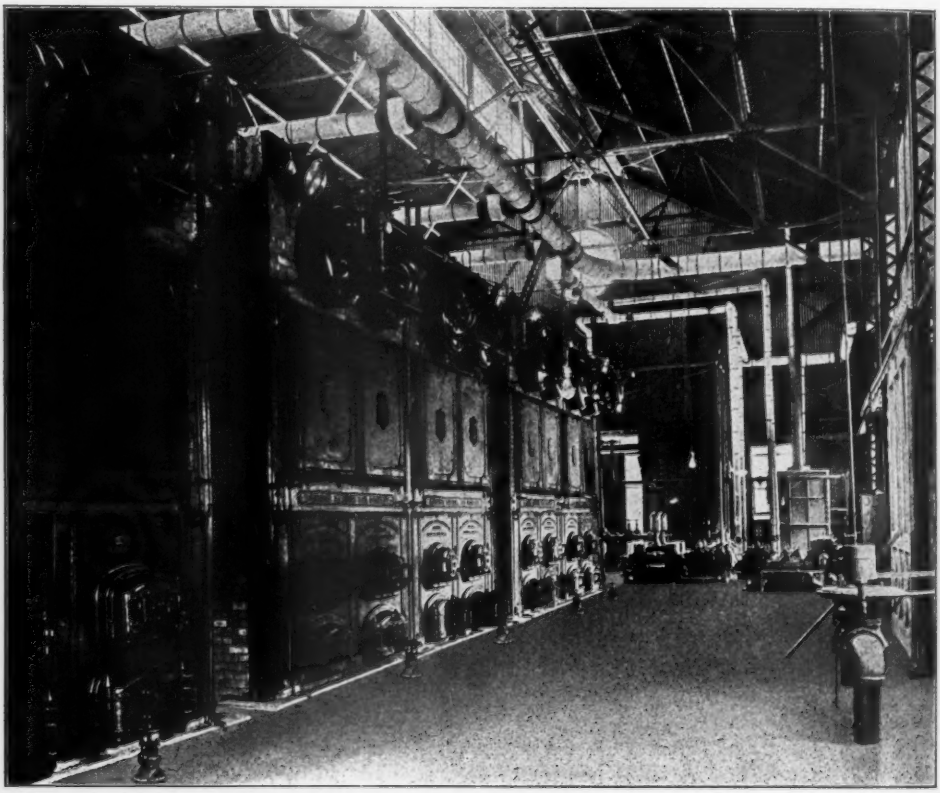


FIG. 1—BOILER-ROOM AT THE HUNDRED, W. VA., COMPRESSING PLANT.

Figure 1 is a photographic view of the boiler-house, in the end of which are lo-

cated some of the auxiliaries. The feed water reaches the boilers through a Cochrane open heater at 210 degrees Fahr. Steam from the feed pumps, the condenser pumps and the electric light engine is passed through this heater, and the piping arrangement allows the hot well water to also be passed through the heater. The piping arrangement allows for all possible contingencies, for feed water may be drawn from either the cold water reservoir, the hot wells or through the heater.

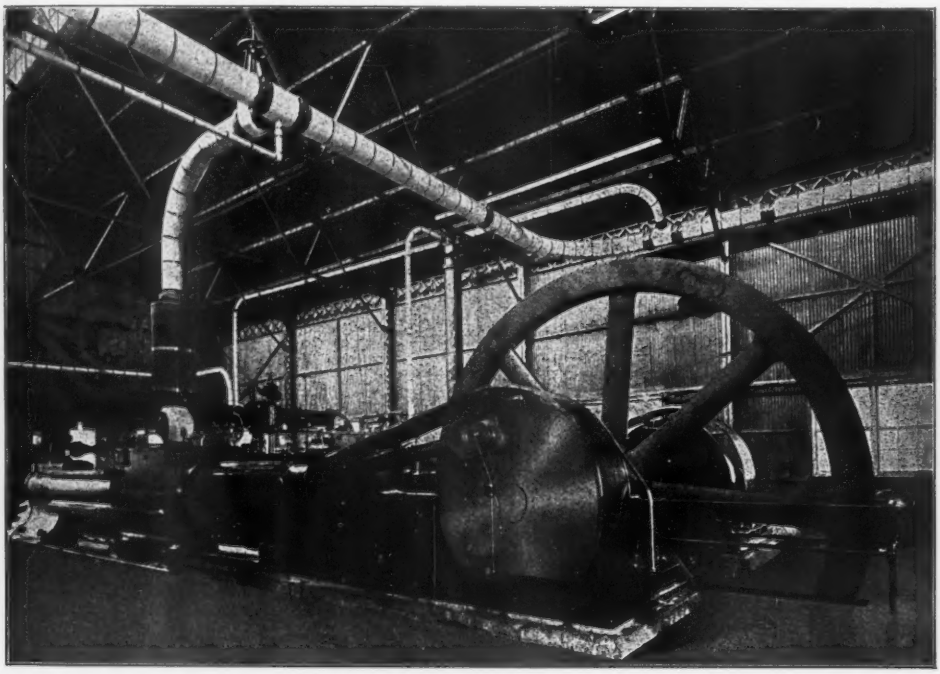


FIG. 3—GENERAL VIEW OF COMPRESSOR, HUNDRED, W. VA.

The steam piping is of wrought iron, and all joints over 3 inches are flanged. The flanges in the 10-inch steam line are of rolled steel and peened to fit.

The main steam line consists of a closed loop of 12-inch pipe with long-radius bends. Along one side are the 8-inch lines to the boilers, while along the other side are the 10-inch branches to the compressors. Branch pipes to the auxiliaries are taken from this loop. Such an arrangement is simple and at the same time allows easy manipulation. Expansion is taken care of very nicely without the use of any expansion joints or extra loops.

The compressors are the Rand Drill Company's cross-compound, heavy-duty type, with steam cylinders 32 and 60 inches in diameter, air cylinders of 21 inches and a common stroke of 60 inches. They have a capacity of 15,000,000 cubic feet of free gas per day of twenty-four hours, running at 50 revolutions per minute. The capacity of both compressors is, therefore, 30,000,000 cubic feet. The intake pressure is 50 pounds per square inch, and the discharge pressure 300 pounds, thus developing about 3,000 horsepower in both compressors. Steam enters the high-pressure cylinder at 150 pounds pressure, and the cut-off for the conditions mentioned is made one-quarter

stroke. A view of one of the compressors from the high-pressure side is shown in Figure 3. The vertical separator seen in Figure 3 is a Sweet. A 20-inch exhaust pipe leads the exhaust steam to a jet condenser made by the Snow Steam Pump Works. The steam end of the compressor is a regular type of Corliss with a reheating receiver between the two cylinders. The gas cylinders have poppet inlet and poppet outlet valves of special design, which allow a free and easy passage to the air.

The inlet valves of the compressors are of special construction to prevent them from being sucked into the cylinder, and the top and ends of the cylinders are hooded to form a closed passage for the gas from the inlet pipes to the inlet valves. The discharge is from the side of the cylinders. At the point where the discharge enters the main pipe line the pipe is tapped for an inch pipe, which leads to the compressor house and to a gas pressure regulator which works in conjunction with the speed governor automatically on the cut-off by which the speed is controlled.

As before stated, the gas outlet is at the bottom of the cylinders, and each discharge leads to the outside of the building and thence along the bed of the stream shown, to a point where they join in a common main. The simplicity which characterizes the steam piping is also evident in the gas piping, and provision is made in the suction pipe to deposit any sand which may come along with the gas.

By having the discharge lines at the bottom of the cylinder, the expansion caused by the heat of compression is better taken care of.

Eighteen million cubic feet of gas per twenty-four hours are delivered through 10 and 16 inch pipe for a distance of 90 miles.

Condensing water is furnished from the stream, in the bed of which the plant is located, and in which the amount of water available may vary from almost nothing to a flood, so that storage capacity had to be provided for in the form of the pond shown. The capacity of the condensers at moderate speed is 35,000 pounds of steam per hour, and condensing water is conveyed in an open sluice to the reservoir. The water runs through the sluice in a thin layer, which, with its circulation in the pond, is sufficient to cool it. Cooling of the compressed gas is accomplished by its passage under the bed of the creek before joining the main discharge line.—*Power.*

Sewer Tunneling with a Shield in Cleveland.

The sewer work in Cleveland has been remarkable for many interesting features which have been described in this journal, and at the present time presents another unusual condition. At one place a main sewer lies for about a mile along one side of the right-of-way of the Lake Shore & Michigan Southern Ry. Co., and the privilege to build the sewer here was only obtained by agreeing to comply with many conditions making the work expensive. An interesting account of the undertaking was contributed by Mr. J. M. Estep to the last number of *The Polytechnic,* the students' journal of the Rensselaer Polytechnic Institute, from which the following notes have been taken:

After the construction of the sewer had been begun the railway company insisted that 9-inch Wakefield sheet piling be used instead of the 2 and 3-inch sheeting specified in the contract for the work. As a result of this action on the part of the railway company the cost of the work was increased about $21 per linear foot.

The top width of the trench was about 20 feet and the average depth about 40 feet. The upper set of sheet piling was 28 feet long. The excavation consisted of dry sand, wet sand, quicksand and clay and sand mixed. The sheet piling was well-driven, but in passing a one-story brick building used as a machine shop, enough of the quicksand found its way through and under the sheeting to cause a settlement in the foundation of the building, and, in consequence, large cracks developed in the brick walls, opening up several inches in width at different points. A few hundred feet east of this place is a large three-story brick building used for manufacturing purposes, located within a few feet of the line of the trench, and it was feared that the safety of the building would be endangered by constructing the sewer in open cut, and after due consideration it was decided to build the remainder of the contract, about 1,100 feet, in tunnel. This plan was finally adopted. The work progressed nicely, more rapidly

than open-cut work, and the construction was so thorough that not the slightest settlement occurred in passing the factory, and no settlement occurred anywhere in the tracks of the railway company; but, where the sewer was constructed in open cut, bills to the amount of hundreds of dollars were paid to the railway company for repairs made to their tracks on account of settlement caused by the sewer.

Owing to the many evident advantages of tunnel construction over open-cut work it was decided to build the section adjoining the one above referred to in tunnel by the same method and of the same construction. In the fall of 1904 the railway company built two additional tracks, one on each side of its two main tracks, so that one of the tracks came within a couple of feet of the line of the sewer trench, and it would have been impossible to have done the work in open cut without violating the State law, which does not allow any obstruction to be placed within 6 feet of the track.

The cost of the open-cut work on this section amounted to $71 per linear foot, and it was thought just and proper to allow the contractor to do the work in tunnel at the price that would have been paid had it been done in open cut, as the work could be performed much more rapidly, and the construction equal to that originally planned. The original contract did not provide for the use of the Wakefield sheet piling, but, knowing it would have to be used in open cut, the cost, $71 per foot, included its use. This would make the cost of the work exceed the appropriation by about $18,000, and it was held by the City Solicitor that the contract could not be changed to tunnel work unless it could be performed within the amount of the appropriation. The contractor finally decided to proceed with the work for $98,250, or practically $60 per foot, a reduction of $11 per foot. The sewer now under construction is 13 feet 6 inches in diameter, and is being built of four rings of No. 1 shale brick laid in Portland cement mortar. From a point 2 feet below the spring line to a point about 4 feet from the crown of the arch, the masonry is laid in Flemish bond, keyed in with rowlock masonry.

The contractor's plant is equipped with two 60 horse-power boilers, one 20 horse-power high-speed engine operating a dynamo having a capacity of 250 incandescent light; one Ingersoll-Sergeant straight line air compressor; one feed pump; one high pressure hydraulic pump for operating the jacks; one hoisting engine for shaft elevator, and other necessary meters and tools to make a first-class plant.

The work is carried on under air pressure. The lock consists of a section of the sewer included between two brick bulkheads 24 inches thick and 24 feet apart. Each bulkhead has a wooden door made of 4-inch tongued and grooved lumber. When closed, the doors press against rubber gaskets to prevent leakage. The lock is of cheap construction and differs considerably from the usual style of lock for such purposes, but the results are quite good. It is supplied with large valves so that the lock can be filled or emptied in one minute or less. Ordinarily a pressure of about 5 pounds is maintained, which is sufficient to keep the tunnel dry and to give a good supply of fresh air to the workmen. When soft spots occur in the excavation the pressure is run up to about 9 pounds; a greater pressure than this would probably "blow out" through the roof, as the hard material in the roof is not thick enough to stand a greater pressure. The excavation is principally a hard, dry quicksand, at times mixed with clay, which makes a good covering to hold the small pressure usually carried. A hydraulic shield is used, by means of which the excavation is carried on rapidly, is of the exact diameter required and smooth finish, and dispenses entirely with the use of timber for protection.

Three-quarter-inch steel is used in the construction of the shield, the total weight of which is about 16 tons. It is 4 feet long and 16½ feet in diameter. The upper half is provided with a "follower" 7 feet long, made of ¾-inch steel, bolted to the shield. The "follower" prevents the roof from falling and is a protection to the workmen. When the roof is of hard material the "follower" is pulled off of the brickwork about 2½ feet.

The shield is equipped with twelve hydraulic jacks, 5 inches in diameter and 26 inches long. The water is conveyed to the jacks by a pipe line containing a swinging joint in the shape of an inverted "V" with the joint at the apex, which allows the shield to be shoved ahead and to pull the pipe with it. The pump sup-

plying the water to the jacks can be operated to a pressure of 6,000 pounds, but the average pressure used in shoving the shield is about 700 pounds.

The miners excavate ahead of the shield about 2 feet. The signal is given and the hydraulic pump in the engine room is set to work, and the pressure applied to the jacks shoves the shield ahead into the part previously excavated. At the beginning of each day's work the heads of the jacks stand about 1 foot from the brickwork. Large wooden blocks are placed against the two outer rings of the brickwork and the other blocks placed between these and heads of the jacks. The pressure is transmitted through the blocks to the brickwork, and the latter is not injured in the least. Any bricks that may be loosened are taken out and relaid. After the first shove of 2 feet or 26 inches, the limit of the jacks, the jacks are forced back and more blocking placed between them and the other blocks. The same process is repeated each time a shove is made.

All material is handled in cars of about one cubic yard capacity. The cars are pushed in and out by laborers.

The tunnel is being constructed within 3 feet of the north track of the railway, and no settlement whatever in the tracks has so far been apparent. This method of tunneling has demonstrated its superiority over open-cut work. The work can be carried on continuously day and night, and at all seasons, regardless of the weather. The mortar is mixed in the tunnel at the face of the work, and can easily be watched by the inspectors. It requires few laborers, and much more rapid progress can be made than in open cut. The average rate of progress in open cut on the same size of sewer at the same depth is from 125 to 150 feet a month. The tunnel at present is being built at the rate of 9 feet a day, or about 250 feet a month. Ten feet a day could easily be made, but the contractor does not want to take too great chances by pulling the "follower" off the brickwork any farther than he is doing at present. Two masons lay up the 9 feet a day in about eight hours, and any amount over that would necessitate an extra mason. Each mason has to lay about 5,000 bricks a day, which constitutes a good day's work. There are 8 cubic yards of excavation in each linear foot of sewer and 2.62 cubic yards of masonry, or about 1,100 bricks per linear foot.

In the following tables the gangs have been arranged according to shifts, giving the number of men to each shift and the wages paid. The superintendents are the contractor's sons, and their wages have been estimated at $5 per day. The other wages have been learned from the men themselves. In some cases the wages are rather low, but the laborers are mostly Polaks.

First Tunnel Gang, 11 p. m. to 7 a. m.		
1 head miner, at $4	$4 00	
3 miners, at $3.50	10 50	
2 muckers, at $2.50	5 00	
1 double team, at $5	5 00	
		$24 50
Second Tunnel Gang, 7 a. m. to 3 p. m.		
Same number as first gang		24 50
Total for tunnel gangs		$49 00
Brick Shift, 3 p. m. to 10 p. m.		
2 bricklayers, at $8	$16 00	
4 tenders, at $1.75	7 00	
2 car pushers, at $1.75	3 50	
		26 50
Top Gang, 7 a. m. to 5.30 p. m.		
4 laborers, at $1.50		6 00
Day Shift, 7 a. m. to 7 p. m.		
1 superintendent, at $5	$5 00	
1 engineer, at $3.25	3 25	
1 fireman, at $1.75	1 75	
1 carpenter, at $2	2 00	
4 car pushers, at $1.75	7 00	
1 car dumper, at $1.75	1 75	
		20 75
Night Shift, 7 p. m. to 7 a. m.		
1 superintendent, at $5	$5 00	
1 engineer, at $3.25	3 25	
1 fireman, at $1.75	1 75	
4 car pushers, at $1.75	7 00	
1 car dumper, at $1.75	1 75	
		18 75
Total labor for 24 hours		$121 00

At the present rate of progress of 9 feet a day, the cost of labor per foot of tunnel is $13.45. The estimated cost of the plant, including the shield and jacks, is $13,000, or about $8 per linear foot of tunnel. The fittings include rails, pipe, wire, lamps, floor timbers, coal and other supplies.

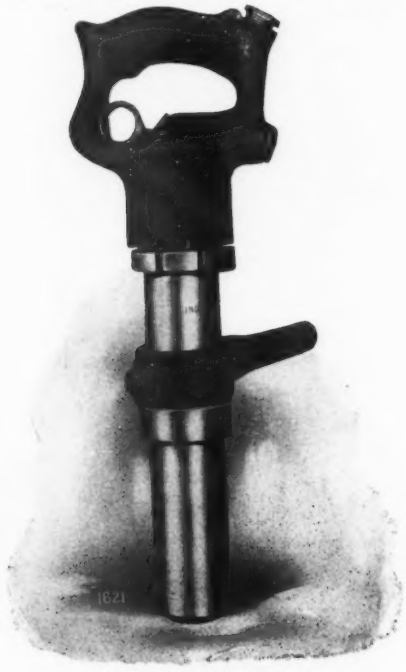
The estimated cost of the work per linear foot, on a basis of 9 feet a day, may then be summed up as follows: Labor,

$13.45; plant, $8; fittings, $4.50; brick, $9.90; cement and sand, $3.70; total, $39.55.

The daily labor item of $121 is the same, whether 9 feet or less are made a day. Bad material would check the progress to 6 feet or less a day, and the cost per foot would consequently be increased. It is quite probable that higher wages in some cases may have to be paid as the season for other work opens up. The cost per foot as given above is only for the tunnel work, and does not include shafts or manholes, but these items ought not add more than $1 a foot to the cost as given above.—*The Engineering Record.*

The "Little Jap" Hammer Drill.

A recent addition to the line of standard rock-drilling appliances built by the Ingersoll-Sergeant Drill Company has been given the trade name of the "Little Jap" Hammer Drill. While the ordinary piston drill, built for more than thirty-five years by this same company, is a development of the original churn drill, in which the steel was plunged back and forth against the rock, the "Little Jap" is an application of the totally different principle of hand drilling, in which the steel remains against the rock and is struck repeated blows by a rapidly moving hammer. The new machine is designed for the lighter work of rock excavation in mines, tunnels, quarries, general contracts; in fact, for all purposes where rock is to be removed.



NO. 2 "LITTLE JAP" HAMMER DRILL.

NO. 1 "LITTLE JAP" HAMMER DRILL.

The new drill is built along the same general lines of design which mark the Haeseler pneumatic tools, built by the same company. It is distinguished by the use of the Haeseler axial valve, a device which has proved its superiority in the most severe service of pneumatic tool work. In principle it is a radical departure from the common forms of reciprocating valves with straight-line motion heretofore used. By its strength of construction, its freedom from wear, its steadiness in action, and its absolutely novel design, it overcomes the defects which had come to be recognized as almost unavoidable. As the name implies, the axial valve has a movement

around a fixed axis of trunnion, the travel in opening and closing the air ports being caused by the difference between a constant pressure on the short wing and an intermittent pressure on the long wing of the valve. Pressure being equalized on all sides, the arrangement is distinctly a balanced valve, with consequent freedom from undue friction, retardation and wear. Selected materials are used in every part of the machine. Valve, valve box, cylinder and hammer are of special steel; the latter hardened and ground to a plug fit. The shank of the steel slips freely into a hexagonal opening in the front cylinder bushing and is struck by the hammer in its travel. Except with the style of the Little Jap known as the No. 1, hollow steels are used, and a portion of the exhaust from the drill passes through the steel, blowing out the chips and clearing the hole in front of the bit. Such an arrangement would prove decidedly disagreeable to the operator in blowing the cuttings into his face were it not that a collar is mounted on the cylinder through which a part of the air is discharged against the mouth of the hole, throwing the chips to the side instead of outward.

Another valuable function served by the air discharged through the steels is in cooling the bit and retaining the temper under the severe service of drilling a dry hole. The hollow steels are made of a high grade weldless steel tubing and can be redressed as long as the material remains. In this respect they are vastly superior to steels of the ordinary type, made up of a tool steel bit and shank forged to an intermediate section of cheaper tubing. The shank of the steel which receives the hammer blow is hardened, and in service there has been found to be no tendency to batter or spread. The bit is forged to a rosette shape by means of a special dolly.

The "Little Jap" hammer is made in three styles, adapting it for various conditions. No. 1 is furnished with a hand grip, a finger throttle valve and a simple, positive, automatic, rotating device mounted on the front head. This machine uses solid steels and is intended for the very lightest work, such as drilling pop and wedge holes in mine and quarry.

THE NO. 2 "LITTLE JAP" HAMMER DRILL.

THE NO. 3 "LITTLE JAP" HAMMER DRILL IN THE PENNSYLVANIA RAILROAD TUNNEL UNDER THE EAST RIVER, NEW YORK.

Its recommended performance is a ¾-inch hole drilled to a depth of 6 inches; but holes of greater depth and diameter can be drilled with it. In the hardest granite a ¾-inch hole can be drilled to a depth of 3 inches in 15 to 25 seconds. It may be operated in either horizontal or vertical positions, for up, down or inclined holes.

The No. 2 "Little Jap" has a hand grip also, but instead of an automatic rotating device, a hand lever is mounted about midway of the cylinder. In operation the handle is grasped in one hand and the rotating lever in the other. The drill is forced forward with the bit against the rock, when the valve is opened by the finger and the lever swung back and forth, rotating the entire tool through a portion of a circle and producing a round hole. This style uses a hollow steel and has the collar air discharge already described.

In the No. 3 "Little Jap" the hand grip is replaced by a back head mounted on the plunger of a long pneumatic cylinder. This cylinder is clamped on a tunnel column, shaft bar or tripod, and air admitted behind the plunger forces the drill and steel forward against the rock and holds it there as the hole deepens. The total travel of the plunger is 16 inches and the complete device constitutes the automatic pneumatic feed.

The two machines last described are adapted for somewhat heavier service than the No. 1. Both use the hollow steels and drill an air-cleaned hole by means of a rosette bit. They are equally adapted for hard, medium or soft rock, their performance of course depending upon the character of material encountered. Their drilling capacity is a hole of diameter up to 1½ inches to a depth of 48 inches. A 1¼-inch hole can be drilled in hard granite or quartz at the rate of 4 to 5 inches per minute with these machines. In sandstone, limestone and similar soft material, a rate of 8 to 10 inches per minute can be made with a hole of the same size. One man with the "Little Jap" can easily drill 40 to 150 feet per day, equivalent to the hand work of 10 to 12 men.

The machine is simple, powerful and reliable, and requires no skilled labor to operate it. Its compact, self-contained construction and great simplicity adapt it well to the rough service of rock excavation. It is portable in the true sense of the word, and is so compact that it may be operated as a hand machine in spaces too restricted for the use of a hammer in ordinary hand drilling.

The "Little Jap" is especially intended for such work as sinking pop holes, putting in plug and feather holes, stoping, squaring up, cutting hitches, trimming walls, drilling anchor holes, and similar service. So handy a machine is sure to find other unexpected uses. For instance, using a chisel instead of a drill bit, it may be used as a chipping hammer, or by inserting a rivet set in the front cylinder bushing, it may serve as a riveting hammer in repairing mine cars, buckets, boilers, skips and similar work. While a new device, it is in no sense an experiment, having been given long and severe test before it was placed on the market. As an evidence that the "Little Jap" is filling a recognized place in the field of rock excavation it may be stated that the Homestake Mining Company, Lead, South Dakota, has 31 of these machines in service, and in proof of its confidence is adding to the number almost weekly. The new drill is in use in dozens of the representative mines and quarries of the country, where it is making a good record as a labor-saving device.

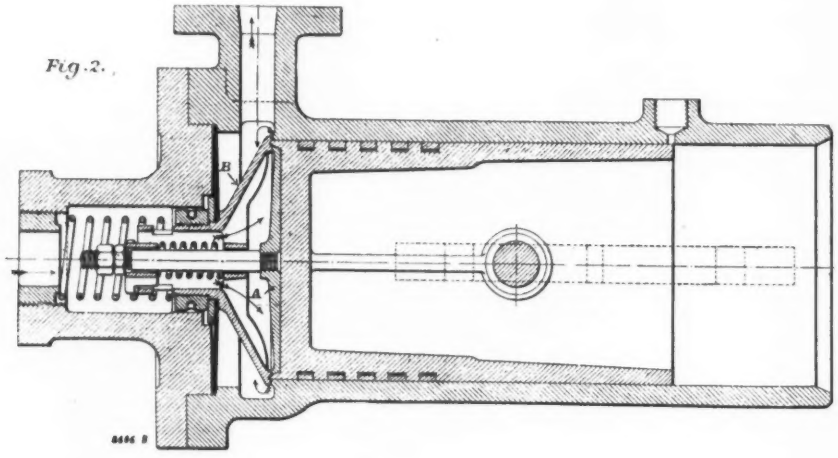
The Kryszat Air Compressor.

One of the most important points in the design of air compressors, particularly of those intended for high compression, is the reduction of the clearance volume between the seating of the delivery valves and the piston to the lowest possible amount. If the clearance amounts to any appreciable proportion of the cylinder volume, the compressed air remaining unexpelled when the piston is at the end of its stroke will again expand behind the piston as it returns, and very much lessen the amount of free air which can be dealt with at every stroke. In the Kryszat air compressor the valves are so arranged that there is no clearance whatever behind the piston, and, consequently, the volumetric efficiency is practically unity. It is single-acting and built very much on the lines of a small gas engine. Air is drawn in through the centre of the cylinder cover and discharged through the vertical branch near the back end of

the cylinder. The arrangement of the valves is seen in Figure 2, which is a vertical section through the cylinder and cover. In this illustration *A* represents the suction valve and *B* the delivery valve. The latter is carried by a circular diaphragm of sheet metal, held in the counter-bore of the cylinder by the cover. The seating of the delivery valve is formed on the inner end of the cylinder barrel, and the valve is held to its seat by the larger helical spring shown, the pressure of which can be adjusted by the screwed collar in the suction orifice. The suction valve is in the form of a flat disc, until the piston actually comes in contact with the surface of the suction valve without danger.

The compressors are made in two sizes, having cylinders respectively 4 inches and 6 inches in diameter, with a 4-inch stroke. Owing to the small lift of the valves and the short stroke of the piston they can be run at about 300 revolutions per minute, ring lubrication being provided for the crank-shaft bearings. The patent rights of this compressor in this country have been acquired by Messrs. Schaffer & Budenberg, Limited, Manchester.—*Engineering* (Eng.).

Fig. 2.



the seat of which is on the face of the delivery valve, to which it is held by the smaller helical spring. When the piston starts on its forward stroke, the suction valve is lifted, and free air enters the cover and passes into the cylinder through the centre of the delivery valve. When, on the return stroke, the air is sufficiently compressed, the two valves move back together, and the air escapes into the delivery belt and emerges by the vertical branch. Owing to the large diameter of the valves, a very slight lift is necessary to give free passage to the air when entering and leaving the cylinder, and it will be seen that the clearance may be reduced

Air Consumption of Drills.*

The accompanying is a tabulation of the amount of free air used per minute per drill employed at the Champion mine during February, 1905. The general conditions of work are as follows: Four shafts are operated; these are approximately in a straight line about 1,000 feet apart. The compressor is situated about 1,000 feet from the first shaft and 4,000 feet from the last shaft. The pipe line is 12 inches

*By R. B. Seeber in *The Engineering and Mining Journal*. The Champion is one of the South Range copper mines, in Michigan. Mr. Seeber is chief engineer.

for 1,000 feet and 10 inches for the remainder of the surface line. The main line down each shaft is 8 inches, with branches at the levels, which are 125 feet apart. The deepest level is the ninth. The compressor was made by the Nordberg Manufacturing Company, and is quadruple-expansion steam, two-stage air. The number of drills in use is about 75. These are of the Ingersoll-Sergeant make, No. D-32, with a 3⅛-inch cylinder. The miners go down at 7 and are hoisted at 5, shut down about 5.15. Saturdays it is shut down at noon. The air pressure carried is usually about 78 pounds, but begins to drop at about 4.30 with the blasting, and the compressor speeds up to keep it as high as possible until 5, when the compressor is allowed to slow down and is stopped at 5.15. The 5 o'clock air pressure is usually about 50 pounds, but sometimes is as high as 70 pounds, depending upon the blasting.

The other machinery using air on both

CUBIC FEET FREE AIR PER DRILL PER MINUTE. CHAMPION COPPER COMPANY. FEBRUARY, 1905.

	Day Shift.				Night Shift.				Drills Working.
	5—8 About 75 Min.	8—11 3 Hours.	11—2 3 Hours.	2—5 3 Hours.	5—8 About 75 Min.	8—11 3 Hours.	11—2 3 Hours.	2—5 3 Hours.	
1	63.45	62.98	65.49	71.44	62.04	52.95	57.50	56.72	75.5
2	60.08	62.41	63.35	64.12	63.19	50.43	66.46	54.32	76.
3	56.94	59.77	60.57	70.50	62.77	52 20	64.19	50.63	75.
4	58.18	67.95	.....	.....	.....	.....	.....	.....	74.
6	57.63	73.08	69.84	67.14	61.76	53.03	60.17	62.42	74.5
7	64.82	64 19	73.02	65.45	63.09	54.88	58.03	63 24	75.
8	61.48	69.11	63.63	64.12	69.42	51.67	59.14	62.26	76.
9	63.19	66.69	63.81	74.07	65 21	55.87	58.21	65.83	76.
10	65.22	65.52	60.70	65.83	66.92	49.98	58.67	61.78	76.
11	70.97	65.57	.....	.....	.....	.....	.....	.....	74.5
13	57.00	66.21	61.11	66.21	63.80	59.85	57.00	60.03	74.5
14	63.51	71.92	66.37	72.85	65.02	61.76	59.24	55.57	74 5
15	66.69	67.18	62.08	68.11	65.09	54.64	63.66	59.51	74.5
16	59.30	65.99	64.12	70.66	70.51	54.94	54.16	57.12	76.
17	65.17	64.86	64.86	64.86	72.53	56.57	54.20	55.77	75.5
18	63.30	69.99	.....	.....	.....	.....	.....	.....	72.5
20	54.16	75.02	65.21	62.88	67.23	53.85	59 92	61.95	76.
21	73.93	76.89	69 88	62.41	72.84	54.01	60.70	59.92	76.
22	79.84	59.92	65.52	79.69	71.13	56.19	67.55	58.83	76.
23	70 80	65.83	66.61	71.13	70.35	50.11	60.54	64.43	76.
24	70.19	68.32	69.88	68.18	59 77	58.58	54.00	61.47	76.
25	63.51	71.92	.....	.....	.....	.....	.....	.....	74.5
27	52.17	73.32	66.58	68.46	67.06	56.24	71.60	56.56	75.5
28	56.30	64.34	64.34	70.49	61.52	59.45	52.35	62.14	75.
	1,517.83	1,618.93	1,306.97	1,308.60	1,321.25	1,097.20	1,197.29	1,190.59	1,805.00
	63.24	67.45	65.35	68.43	66.06	54.86	59.86	59.52	75.21
		67.10				58.09			

both day and night shift. They probably begin drilling about 8 and stop at 12, begin again at 1 and stop at 3.30, blasting before 5. The valves are usually left open to clear away the smoke. The valves are closed by the next shift. Saturdays the miners come up at noon, and the Saturday night shift is composed entirely of trammers.

The compressor is started at about 7 o'clock both morning and evening, and

shifts is as follows: Two small hoisting "puffers"; three steam hammers in the rock-houses for cleaning mass copper, 11⅞-inch cylinders; four air-hoists for handling large rocks in the rock-houses, 10-inch cylinders. None of these is in continuous use. In addition, on the day shift about 50,000 gallons of water is raised by various pumps, all attended by one pumpman. Two drill-sharpening machines sharpen about 500 bits per day, be-

tween 8 A. M. and 5 P. M. A 200-pound pneumatic hammer in the blacksmith shop is used occasionally. Some air is also used in trying out drills which are under repairs.

A log is kept at the compressor house giving the reading of a revolution counter every three hours. The time of stopping and starting is always recorded. Lengths of periods tabulated under 5 to 8 average about 75 minutes in length, while all the others are the full three hours in length. From 230 to 250 cubic feet free air is compressed for every pound of coal burned under the boilers.

The Uses and Advantages of the Combined Automatic and Straight-Air Brake.*

Ever since the air brake has come into general use there has been a demand on the part of engineers for some modification of the engine and tender equipment which would permit of the brakes on these vehicles being used more or less independently of the train brakes when so desired. As the changes in apparatus embodied in the original suggestions contained features which might, at times, interfere with the proper manipulation of the automatic brakes, air brake inspectors and instructors were averse to recommending their use. But conditions, such as heavier engines, larger capacity cars, the number of cars hauled in trains, etc., have practically made an improved engine and tender equipment imperative not only for switching and freight service but for long passenger train service as well.

While it has since developed that the most general use and the many desirable results are obtained in freight road service, the introduction of the combined automatic and straight air brake was the direct result of the conditions encountered in switching service, where the release and recharge of the automatic brake can never be said to have properly met the existing conditions. The frequent movements of switch engines in different directions make it very desirable that either a quick, slow, or gradual-release and application be possible, while in train service a slow or a temporarily postponed release on an engine is advisable to hold the slack from running out too fast at the front of the train when a release of the brakes is desired. It is also essential in switching service that a prompt recharge be possible. The size of the feed port in the triple, necessarily small, in order to obtain uniform results throughout long trains, makes this impossible. The engineer on the switch engine is thus forced to use the brake and the reverse lever alternately to permit of the recharging of the auxiliary reservoir in the otherwise limited time available between the brake applications. The evil results of this practice are manifested by the more rapid tire wear and the cutting of valves, valve seats and cylinders by cinders. While there may at first be an inclination toward skepticism in regard to the marked benefits resulting to the tire, it may be stated that three engines on an ore road, where the service on the tires is severe, started out on a new season last year without any work on the tires, which had already a mileage of 125,000 in each case to their credit. This is accounted for in part from the fact that the brakes may be applied as often as usual, so long as there is any air in the main reservoir—the use of the reverse lever thus being avoided.

In freight service there are a great many times when this equipment is necessary, if the best and most economical results are to be obtained. By this is meant the smooth handling of trains, additional safety, economy of air resulting in fuel economy, and less damage to freight and equipment.

General Description of Operation.

In placing this equipment, commonly known as the combined automatic and straight-air brake, or Schedule S. W. A. —S. W. B., on the engine and tender, nothing is disturbed except to cut the pipe leading from the triple valve to the brake cylinder on the engine and tender, also the pipe leading from the main reservoir to the brake valve; double check valves are inserted at the former places and a tee at the latter, as shown in the accompanying diagram Figure 1. The double check valves, Figures 1 and 2, are at the junction of the automatic and straight-air pipes leading to the brake cylinder. The tee in the main reservoir pipe connects this pipe with a reducing valve adjusted at the maximum pressure desired for use in connection with the straight-air. Air

* Paper read by Mr. Robert H. Blackall (Assistant Mechanical Engineer of the Westinghouse Air Brake Co.), before the New England Railroad Club, January 10, 1905. Cuts published through the courtesy of "Railway Machinery."

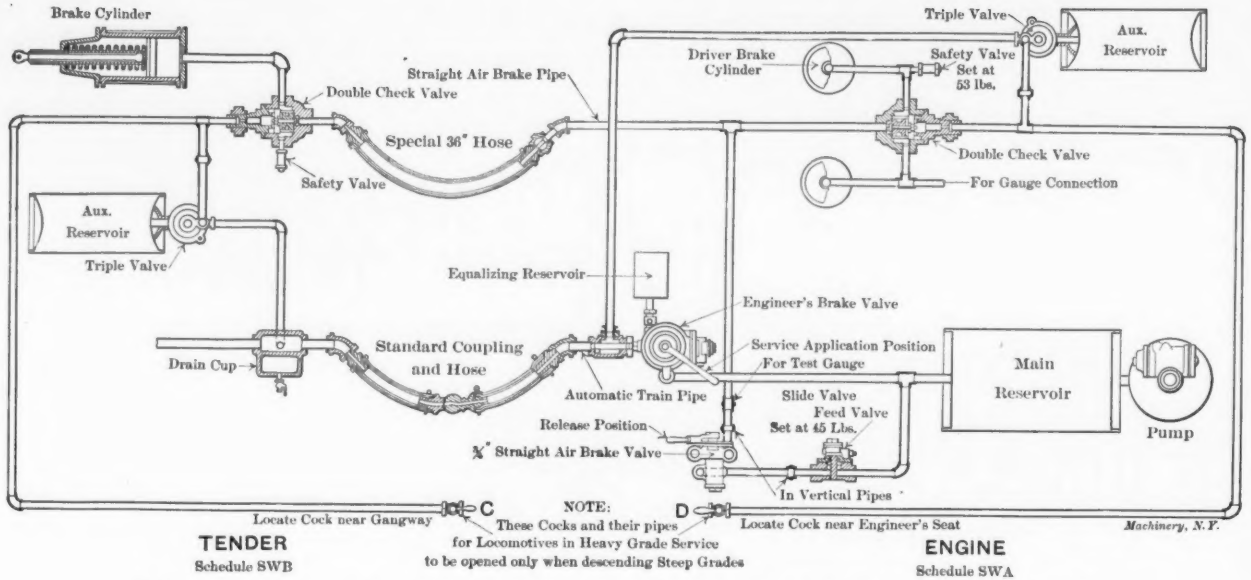


FIG. I.—DIAGRAM SHOWING METHOD OF PIPING THE COMBINED AUTOMATIC AND STRAIGHT-AIR BRAKE

passing through the reducing valve is piped to the straight-air brake valve, Figures 1 and 3, which is usually located on the side of the cab in such a position that it is within convenient reach of the engineer, especially when doing switching service. This valve has three positions: release position, which permits brake cylinder pressure to escape to the atmosphere; lap position, in which the ports are closed and the valves seated; and application position, in which main reservoir pressure, reduced to 45 pounds by the reducing valve, flows through the double check valve to the brake cylinder.

The double check valve contains ports controlled by a double piston with leather faces. One side controls the flow of air from the triple valve, and the other from the straight-air brake valve to the brake cylinder, the double piston or check always acting to close off the ports from the triple when the straight-air is in use, and *vice versa*. If one is applied lightly, and it is desired to apply the other, this can be done, any pressure above a safe amount being vented to the atmosphere by a safety valve. Too much braking power could only be obtained if the straight-air were applied and the automatic were then used, but this would only be true if the safety valve failed to perform its function. There is no chance for too much braking pressure if the automatic is applied and the straight-air is then used, since the reducing valve closes as soon as the pressure between it and the straight-air brake valve is 45 pounds, or that for which the reducing valve is adjusted.

Slight modifications in the equipment are made when this device is used in switching or passenger equipment; these are covered in the notes found in connection with the illustration of the device.

For mountain service, what is known as the "mountain cock" is inserted both on the engine and tender. This cock consists in an ordinary half-inch cock placed in a pipe which leads from between the double-check valve and the triple valve. The cock on the tender is located in the gangway where it can be operated by the fireman. The one for the driver brake is placed in the cab within reach of the engineer. In descending long grades, where the work of the brake is such as is liable to overheat the tires, these valves are opened to permit any air that may come from the triple valve, in response to a reduction of train pipe pressure to escape to the atmosphere. This does not affect the use of the straight-air in the least, and, if desired, this brake may be, and is, used to aid the retaining valves in keeping the speed of the train from increasing too rapidly while a recharge is being accomplished. It may also be used, if desired, to help control the train at any time, though usually but for a short distance, when existing conditions may warrant some extra power being used to control the speed of the train. When the foot

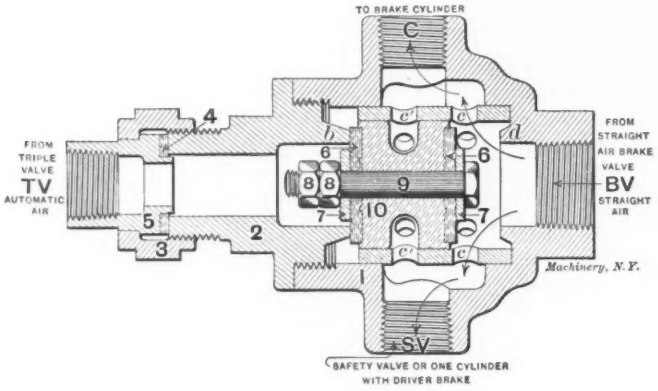


FIG. 2—DOUBLE-CHECK VALVE.

of the grade is reached these valves are closed and the brakes are used in the customary way.

While in the past it has not been customary to use a separate gauge for the straight-air this practice is coming into use and is one that cannot be recommended too strongly, as it permits the engineer to tell what braking power he is using on the drivers and enables him to do much more intelligent work. This gauge is also an important adjunct in the maintenance of the packing leathers, as it affords a means of determining the exact condition of the leathers by the engineer and repairmen. It may also be coupled up in such a way, with suitable piping and cocks, that it may be used to test the signal pipe pressure. When used with this equipment the pipe connection should be to the pipe between the brake cylinder pipe and the double check valve, so that it will show the cylinder pressure when either the automatic or the straight-air brake is used.

Advantages.

The following are among the chief advantages that may be obtained by the use of the combined automatic and straight-air brake:

1. A constant braking power, regardless of the amount of piston travel, and regardless of cylinder leakage within a reasonable amount, may be obtained.

2. It permits of more frequent and quicker movements in switching. This is true, since it is not necessary for the engineer to wait for the auxiliary reservoirs to become recharged between brake applications.

3. The release, or application, is practically instantaneous, if so desired, or it may be graduated, at the pleasure of the engineer, with fineness and precision.

4. Its use in many cases permits of a brake release on long trains at slow speeds without danger of break-in-twos and thus does away with many stops due to the danger of releasing brakes at slow speeds.

5. It decreases the percentage of break-in-twos in starting as a release can often be made on the train and the engine and tender brakes retained. This practice permits the shoes to be jarred away from the wheels on the train and allows the engineer to start the train without first taking the slack. Many break-in-twos occur on account of the engineer trying to jerk a heavy train to a start while the brake shoes are still clinging to the wheels.

6. Its use prevents many break-in-twos due to slack running in or out on account of change in grade or curvature.

7. It permits of considerable economy in air consumption, as the speed of a train may be reduced or the train may be stopped when the brake work is inconsiderable. This use, aside from the resultant air economy, increases the life of the pump and does away with much wheel sliding caused by stuck brakes, which results most frequently after light train-pipe reductions. The saving in air consumption will readily be appreciated when we consider that many stops are made with a train pipe reduction of but five pounds. Such a reduction gives an average cylinder pressure of approximately six or seven pounds. This pressure is barely more than sufficient to overcome the tension of the brake cylinder release spring, the friction of the levers, pins and rods, and barely brings the brake shoes against the wheels. The power of the straight-air corresponds with the power of the engine; hence, if the slack is first bunched, and the straight-air power then increased gradually, the train can in many cases be controlled without its being necessary for the train brakes to be applied; this means, among other things, that it will not be necessary for the pump to supply all the air taken from each auxiliary reservoir. In a train of fifty cars this is an important item.

To obtain an idea of the amount of air that is often used unnecessarily in an automatic application of the brake which is the result of a train-pipe reduction of five pounds, it might be well to check over the actual conditions. Supposing the cars to be using the eight-inch equipment, the engine fourteen-inch and the tender twelve-inch equipment, two cylinders to be used with the drivers and one with the tender. Forty feet has been taken as the length of the train and cross-over pipe on each car and the engine and tender. The actual amount of free air used from the train-pipe and auxiliary reservoirs in response to a five-pound reduction is 40,207 cubic inches.

If, instead of using the train brakes, the combined automatic and straight-air brake on the engine and tender were used, a full application of the brake would use but 11,426 cubic inches of free air, showing

an actual saving of 28,781 cubic inches of air. This is the saving made where large driver-brake cylinders are used on the engine, and where a full application of the straight-air brake is made; the saving would be correspondingly greater where the cylinders were smaller or where a lighter application was made. This saving is the theoretical, and the actual is still greater, since it is not customary to make as light reductions as this on trains of fifty cars, and after a reduction has been made a still greater use of air is made, due to train-pipe leakage, which causes the triple valves to still further deplete the pressure in the auxiliary reservoir. The figures given above show the very smallest amount of air saved with but a five-pound reduction of train-pipe pressure, as compared with a full application of the brakes on the engine and tender when using the straight-air. The saving accomplished means an increased life of the pump as well as a saving in fuel and longer life of tires between "shopping."

8. It is seldom that one stops to think of the work that can actually be accomplished by this equipment on the engine and tender or we would more readily understand the immense amount of air that could be saved, aside from the many other advantages it makes possible. The actual amount of braking power developed by the straight-air brake with a cylinder pressure of but 45 pounds, where the weight of the engine on the drivers is

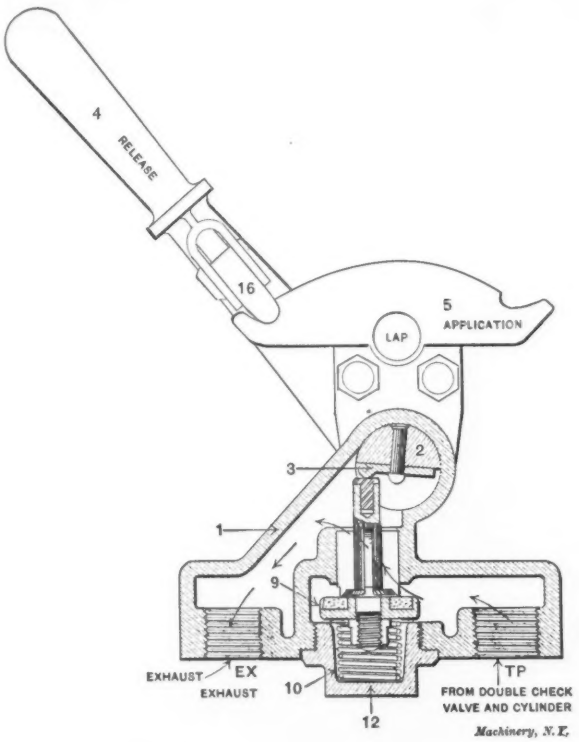


FIG. 3—STRAIGHT-AIR BRAKE VALVE.

200,000, and the light weight of the tender is 70,000 pounds, is a little more than the braking power on eight cars where the emergency application of the brake is used and where the light weight of the cars is 35,000 pounds. It was only a very few years ago that it was the common thing to see but four or five cars of air coupled upon many roads and these brakes were used to make all slow-ups and many of the stops; why not use the brakes on the heavier engines of to-day and obtain greater safety, efficiency and economy?

9. It prevents the slack from running out harshly in heavy grade work and can be used to aid the retaining valves in controlling the speed of a train when a discharge is in process. On moderate grades it will, with the aid of the retaining valves, hold a train a sufficient length of time to permit its being recharged ready for use. This eliminates one of the dangerous features of grade work.

10. With the straight-air brake valve in application position a leaky throttle will not start the engine even if the packing leathers in the cylinders are in poor condition. This being true, it is safe for an engineer to go under his engine when the straight-air brake is applied, although the throttle leaks.

11. It is very efficient in controlling cars that are being weighed, and provides a means of doing away with rough handling where, if this device is not available, accurate work requires the use of the emergency application. In passenger, express and milk train service it is an aid in making accurate stops, and can be used to hold such trains at stations where the grade is heavy and where it is very desirable to have the train recharged before proceeding.

The introduction of this equipment was begun in 1900, since which time there have been upwards of three thousand sets applied; the general use of so many in such a short space of time certainly speaks volumes for the general satisfaction it has given. Fortunately the additional cost of this equipment is so slight that all roads can afford to include it in their specifications, and many railroads have already done this.

The Death of Andrew Onderdonk.

In the great engineering enterprises which have made the last decade one of special importance in the development of Greater New York, there have been several men who have stood prominently before the public. There were the engineers who planned and directed these undertakings and the men who organized and carried out the tasks. Of the latter none was better known than Andrew Onderdonk. His death on June 21 brought to an end an eventful career. He passed away at his summer home, Oscawana, on the Hudson River, June 21, after a lingering illness resulting from overwork and a general breakdown.

Mr. Onderdonk was fifty-six years old, more than thirty-five of which had been spent in the hardest kind of contracting work and competition with rival concerns. He had carried some huge enterprises to completion in his time. For some years prior to 1880 he was engaged as contractor for the harbor improvements at San Francisco, a big job running up into the millions.

Between 1880 and 1885 he built 400 miles of the Canadian Pacific Railroad in British Columbia, the contract amounting to about $18,000,000. In 1886 he engaged in the construction of the Entre Rios Railway in South America. After that he built nine miles of tunnel, a part of the drainage system of Chicago, and in 1895 undertook to construct part of the Trent Valley Canal for the Dominion Government, involving one of the largest rock-cuts in that country. He also built a double-track railway tunnel in Hamilton, Ont. In connection with the Union Bridge Company of this city, he built the Northwestern Elevated Railway in Chicago, and got a contract for four sections of the Soulange Canal in Canada, and for half of the great Victoria Bridge at Montreal. Two of his latest big contracts were the dredging in the Lower Bay for the New Ambrose Channel, and a part interest in the Jerome Park Reservoir job.

Mr. Onderdonk was a bidder against John B. McDonald for the original Subway contract, but was several thousand dollars above the price asked by the man who secured it. Nothing daunted he went after the contract for building the second piece of Subway—the Brooklyn connection—and was successful in getting

what is called the East River tunnel, one of the most difficult pieces of work ever undertaken by a contractor, which has been described in previous issues of COMPRESSED AIR. Soon after getting the award Mr. Onderdonk organized the New York Tunnel Company, which by permission of the Rapid Transit Company, took over the contract, and the work has been pushed toward completion most successfully under Mr. Onderdonk's supervision, and in conjunction with the Rapid Transit Commission's engineers.

MR. ANDREW ONDERDONK.

Mr. Onderdonk was born in New York City and leaves a widow and two sons and two daughters.

Notes.

P. & W. L. Cole, of London, have secured American patent rights for an apparatus for spraying with air for refrigerating purposes.

The old State House at Boston is being cleaned with a sand blast. The building is of granite and the blast changes it from the old dirty black color to a steel gray. Compressed air at 35 pounds pressure was used.

W. C. Stephens, "Endsleigh," Canborne, Eng., has patented an apparatus for laying dust in connection with rock-drilling machinery. Its object is to provide a simpler form of drill than has heretofore been used for the purpose.

The American Society of Refrigerating Engineers has issued its first Year Book. This gives a list of officers and charter members, together with a copy of the Constitution and By-Laws. A copy of this book may be obtained by addressing the Secretary of the Society at Suite 806, No. 58 Broadway, New York City.

A committee appointed by the Second Assistant Postmaster-General has been investigating conditions at Cleveland, O., with the idea of installing a pneumatic tube postal service. This committee will soon make its report. The officials at Cleveland are confident that this report will be a favorable one.

Air compressors are often provided with automatic governors, which regulate the operation of the machine, keeping the air pressure within certain limits as determined by the arrangement of the governor. The allowable variation in pressure generally ranges from 5 to 10 pounds per square inch.—*Mining and Scientific Press.*

The Whitehall Terminal of the Central Railroad of New Jersey having been acquired by the City of New York, the ferry plying between that terminal and the Jersey City Station has been discontinued. A new ferry has been opened, running from the Jersey City Station to the foot of West Twenty-third street, North River.

The special committee of the House of Commons, England, which was appointed to consider the bill providing for the installation in London of a pneumatic tube system, has decided against it. There was considerable opposition on the part of the municipal authorities on the ground that the work would necessitate much tearing up of streets.

The City Council of Iola, Kansas, has awarded a contract to the Leigh Hunt Engineering Company to install a compressed air power pumping plant for its sewage system. In one section of the town it is necessary to raise sewage to a sufficient height so that it may be conveyed to the septic tank. Several methods of pumping were considered, but the decision was in favor of compressed air.

B. Van Nostrand Company, publishers, of New York, has just issued an authorized translation of "Mechanics of Air Machinery" by Dr. Julius Weisbach and Prof. Gustav Herrman. It contains an appendix on American works by Prof. Amasa Trowbridge, of Columbia University. The translation itself deals with the movement of air, natural and artificial ventilation, blowing engines of various types, air compressors, rotary blowers and patents. It is well illustrated. The appendix describes and illustrates the latest American practice along these same lines.

The city of St. Albans, Vt., is to have an air compressor for the purpose of blowing the fire alarm whistle. The air compressor is to be driven by a Pelton water motor of 5 horse-power capacity. The motor will be run by a 5/8-inch stream of water at 105 pounds pressure taken from the line. The compressor will be governed by an automatic regulator which will set the machine when the pressure in the air receiver falls to 90 pounds, and will stop it when the pressure reaches 105 pounds. The work of installation has begun and the apparatus is expected to be ready for work on August 20.

Compressed air appeared in a new role in the London police court recently. The owner of a compressed air cleaning company was hailed to court on the charge of wilfully obstructing a street with his compressed air cleaning machine. The street where the machine was in service hap-

pened to be a narrow one. The defense made was that this was an invention in the interests of health of the people and that to regard such a case as wilful obstruction would deprive people living on narrow thoroughfares from the benefit of the invention. It was claimed that this machine was no more a wilful obstruction than was a delivery wagon or a doctor's carriage. The case was dismissed with costs.

Shops of the Westinghouse Air Brake Company at Wilmerding, Pa., are now rushed with orders for railroad safety appliances. Since the first of the year the company has received contracts for friction draft gear for 150,000 cars for the following roads: Chicago & Alton, Baltimore & Ohio, Bessemer & Lake Erie, Chicago, Burlington & Quincy, Lake Shore & Michigan Southern, Mexican Central, Lehigh Valley, Pennsylvania, Pennsylvania Lines, Philadelphia & Reading, West Side Belt, Duluth, Mesaba & Northern, Duluth & Iron Range, Northern Pacific, and the Butte, Anaconda & Pacific. The company has also received an order from the Missouri Pacific to equip 5,000 cars with air brakes.

A compressed air traction plant working at the pressure of 1,000 pounds per square inch is being built for the United States navy yard at Mare Island, Cal. A Norwalk Iron Works three-stage compressor, running at 140 revolutions per minute, geared from a 30 horse-power Westinghouse induction motor running at 685 revolutions per minute, will furnish the air to a storage tank, from which the locomotive draws a supply sufficient to operate it for six hours. The locomotive built by the H. K. Porter Co., of Pittsburg, Pa., is of 36-inch gauge and can be run at a speed of 6 miles per hour. The two cylinders are 6 inches in diameter by 10 inches in stroke; the engine can haul a train weighing 80 tons.—*Engineering News.*

Sealed proposals, in triplicate, will be received at the Office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until 10.30 A. M., July 31, 1905, at which time they will be opened in public, for furnishing Air Compressors, Pneumatic Hammers, Drills and Boring Machines, Marine Boilers, Rubber Hose, Sheet Iron, Steel Rivets, Salinometers and Salinometer Pots. Blanks and full information may be obtained from this office, or offices of Asst. Purchasing Agents, 24 State St., N. Y. City; Custom House, New Orleans, La.; 26 New Montgomery St., San Francisco, Cal., and Tacoma, Wash.; also Commercial Club, Mobile, Ala. D. W. Ross, General Purchasing Officer.

Harold U. Wallace, son of John F. Wallace who has just resigned the chief engineership of the Panama Canal Commission, has accepted the third Vice-Presidency of J. G. White & Co. Mr. H. U. Wallace resigns as chief engineer of the Illinois Central Railroad to accept this position. He has been connected with that road since 1894 and since 1902 has been its chief engineer. Among other important work carried out for the Illinois Central Railroad by Mr. Wallace was the lake front improvement work at Chicago. This work included the depression and reconstruction of twenty miles of main lines and yard tracks. In securing the services of so distinguished an engineer as Mr. Wallace, the White Company is simply following out its uniform policy. It has of late secured the services of several eminent engineers and it has made its recent selections largely from the steam railroad field.

It may be stated without much fear of contradiction that the possibilities of compressed air as "power" in the quarries and manufacturing establishments of our granite and marble industries have developed more rapidly than the ability to make use of it in the most economical and effective manner. It is a power very easily handled and distributed, and moreover, one whose installation is within the means of any successful manufacturer or dealer. The increasing use of both steam and compressed air in the marble and granite quarries, and the improvement in the design of quarrying implements and machinery and the diversity of use for which machinery is being designed and constructed, have completely revolutionized quarrying methods and have resulted in vastly simplifying operations, and in reducing the cost of the products. This, of course, means a wider use of quarry materials.—*Record and Guide.*

The loss of air between the compressor and the drills may be due to any one or all of several causes. These are leaks in the pipe line; abnormal friction in the pipe line, due to rough pipe and frequent sharp bends; frost in the pipe line in cold weather and water due to condensation of moisture during moderate weather. Another source of annoyance is the leaving wide open of one of the cocks on a hose which has been detached from a machine after blasting for the purpose of driving out the gases and smoke. This weakens the pressure at every other machine in the mine for the time being, unless the compressor is large enough to easily supply the loss due to this cause. Air pipe lines should be of sufficient diameter to admit an easy flow of air through the pipe, and not cause it to travel at a high velocity, thus increasing the friction. It is advisable to use either straight-way or gate valves on air lines, as globe valves cause much loss from friction.—*Mining and Scientific Press.*

The July issue of *Air Power*, the quarterly published by the Rand Drill Co., contains, among other things, a complete description, illustrated by diagrams, of a displacement pump, written by Prof. E. G. Harris; a description of a recent installation of a Compressed Air Mine Haulage System, by A. A. Bowman, M. E.; The Uses of Compressed Air in the Wood-working Shop, by W. R. Hulbert, M. E.; a description of the Construction of the New Duluth Aerial Bridge; an article on the Philadelphia High Pressure Pumping Plant; a practical article on Air Compressor Foundations, by E. M. Mackie, M. E.; three new inventions, as follows: A New Tunneling Machine, a Pneumatic Stake Driver used by Barnum & Bailey, and a device for conveying hot rivets through a metal tube by compressed air.

The rest of the paper is made up of short paragraphs containing odds and ends of useful information which will be of great interest to manufacturers and consumers alike.

A most luxurious process has been invented, that will probably eventually dispose of the great bugbear of housecleaning, which every woman, no matter how notable a housekeeper she may be, invariably dreads.

It is a combination of pipes and hose into a curious machine that cleans by drawing dust and dirt up into separators, which dispose of the waste in hygienic ways. As the dirt is drawn up this way by air suction, there is no stirring up of dust, which is unavoidable with the vigorous broom sweepings that are required at present.

As the machine can be cleaned in every part, it can be used to run over walls and floors, without the seemingly endless tearing up of rooms.

At present it is, more or less, confined to hotels and large places, where the cost of labor more than offsets the cost of putting in the machinery. But it is probably only a question of time until it will be accessible to the average household and prevent many a temporary family exodus. —*Buffalo News.*

The Independent Pneumatic Tool Company of Chicago recently acquired the Aurora Automatic Machinery Company of Aurora, Ill., builders of the "Thor" piston air drills, pneumatic riveting, chipping, calking and beading hammers, piston air motor hoist, pneumatic saws and other air appliances. The general offices of the Independent Company are located at the First National Bank Building, Chicago, Ill., and the eastern offices at No. 170 Broadway, New York City. The officers are as follows: James B. Brady, president; W. O. Jacquette, first vice-president; John D. Hurley, second vice-president; A. B. Holmes, secretary; C. E. Erikson, treasurer; A. Levedahl, mechanical superintendent. The board of directors consists of the following: James B. Brady, W. O. Jacquette, John P. Hopkins, John D. Hurley, Simon Florsheim, John M. Glenn, J. J. McCarthy, C. E. Erikson, Louis B. Dailey. Simon Florsheim is chairman of the board of directors. The plant is equipped with the latest improved machinery, and at present has a capacity of about 1,000 pneumatic tools a month. The makers claim that the Thor pneumatic tools are in use in a large number of plants in all parts of the world, and are giving entire satisfaction.

A motor for pneumatic flue-welding machines has been patented by Daniel S. Cook, of Evansville, Ind., who has assigned a one-half interest in his patent to Ferdinand Grote, of the same place.

The object of the invention is to provide means for returning the piston which is located in a suitable cylinder to its normal position after the piston has been operated by power to do the required work. It is preferable to use compressed air in the operation of the device, and heretofore in many cases valves have been used and required to turn the piston after its working stroke. It is also the object of the invention to do away with the use of valves in this connection, and substitute therefor a spring pressure for returning the piston after its working stroke. The invention may be applied to mechanisms, such as hammers, riveting machines, stamp mills, rock drills, etc., and also it is not confined to the use of compressed air in the operation of the mechanism. The invention consists of a cylinder provided with exhaust ports having screw threads in one head, in which head is screwed a reception chamber communicating with the cylinder. A piston is located in the cylinder with its stem in the chamber. A spring surrounds the stem and exerts its tension between the stem and chamber to return the piston to normal position.—*Modern Machinery.*

The Homestake Mining Company has adopted pneumatic haulage for its gold mines at Lead, S. D., and has just placed an order with the Ingersoll-Sergeant Drill Company for a mammoth duplex four-stage Corliss air compressor to supply the power. Although the Homestake Mine contains low-grade ore, it has proved the richest in the world, paying out nearly $20,000,000 in dividends. This has only been made possible by the adoption of the most improved methods and the installation of machinery giving every possible economy. This question of haulage has only been decided after thorough and complete tests extending over a period of more than a year. One air locomotive was in service during that time, getting its power from an Ingersoll-Sergeant three-stage air compressor. The success of the locomotive and compressor has been demonstrated. Fourteen pneumatic locomotives are now to be installed to supersede the present mule service. The compressor to supply air at 1,000 pounds pressure for this service will be the largest high-pressure compressor in the world and nearly a duplicate of the high-pressure machine which operates the pneumatic haulage system at the mines of the Anaconda Copper Mining Company. There are already seven other Ingersoll-Sergeant air compressors in active service at the Homestake Mine supplying 19,413 cubic feet of free air per minute. Five of these are of the Corliss type, the largest having a stroke 6 feet long.

The Chicago Pneumatic Tool Company has issued a new catalog covering its new type "G" Franklin Air Compressors. The catalog illustrates and lists the various sizes and goes briefly into the construction.

One of the latest devices placed on the market by the Chicago Pneumatic Tool Company is a pneumatic pipe bending machine. It is very simple in construction and requires the services of an ordinary helper only. Piping of iron, steel or other material up to 2 inches in diameter can be bent cold. Its simplicity and lightness make it of special value. Its manufacturers claim it has performed the same amount of work in one-tenth of the time required by any other device now on the market.

The Ingersoll-Sergeant Drill Company and the Rand Drill Company have been united into a new company called the Ingersoll-Rand Company. The new corporation was formed under the laws of New Jersey with a capital of $10,000,000, of which $5,000,000 is preferred stock and the balance common. This is a union of valuable patents and of expert engineers of large experience in this special line of work. It should be advantageous to purchaser as well as maufacturer. Improved machinery and better service should

result. The factories of the two companies are located at Phillipsburg, N. J.; Easton, Pa.; Tarrytown, N. Y.; Ossining, N. Y.; Painted Post, N. Y.; Thirty-fourth street, New York City, and Sherbrooke, Quebec. They will all be operated.

The officers of the Ingersoll-Rand Company are as follows: President, W. L. Saunders, formerly president of the Ingersoll-Sergeant Drill Company; First Vice-President, George Doubleday, formerly treasurer of the Ingersoll-Sergeant Drill Company; Vice-Presidents, Jasper R. Rand, formerly president of the Rand Drill Company; John A. McCall, president of the New York Life Insurance Company; J. P. Grace, vice-president of W. R. Grace & Co.; George R. Elder, general manager of the Manufacturing Department; Treasurer, W. R. Grace, formerly Secretary of the Ingersoll-Sergeant Drill Company; Secretary, F. A. Brainerd, formerly treasurer of the Rand Drill Company.

The main offices of the new company will be located at No. 11 Broadway, New York.

Mr. J. W. Duntley, President of the Chicago Pneumatic Tool Company, returned June 5 from Europe, where he has spent six weeks in the interest of the company. He brought with him orders for 3,400 tools for shipment from America, representing a value of over $300,000.

Mr. Duntley states that the trip was the most successful he has ever experienced and, owing to the growing demand for pneumatic tools in England and on the continent, it was found necessary to extend the organization of the foreign business. In order to accomplish this, the factory and business of E. G. Eckstein, Berlin, Germany, and that of the Lencke Co., St. Petersburg, Russia, were purchased and will be operated for the purpose of meeting these requirements in the continental countries.

Pneumatic tools are rapidly being introduced in shipbuilding and other large industries in Russia, Austria, Germany, Italy, France, etc.

The English Courts, on May 17, rendered the final adjudication of the patent litigation instituted by the English Company, which decision sustained all of the company's claims, 52 in number, covering pneumatic hammers, thus leaving the English Company in a particularly strong position with reference to its patents.

Its plant at Fraserburgh, Scotland, is now in full operation. The American business, according to President Duntley, shows a very satisfactory increase in volume and all factories, both American and foreign, are operating overtime. The month of May was the largest month in the history of the company.

According to the *Engineering and Mining Journal*, a note from R. A. Hadfield, at the recent meeting of the Iron and Steel Institute, at Sheffield, England, says: "As many iron alloys have shown anomalous results in their physical behavior at ordinary temperatures, it became advisable to ascertain the exact effect of very low temperatures upon such bodies, and accordingly a series of tests were carried out on standard iron and steel alloyed with other elements, the specimens being selected from a large collection made by the author of the Hecla Works, Sheffield. In the course of the inquiry, some 500 specimens have been examined. The bars experimented upon were finished a length of 2 inches and a diameter of 0.180 inches between punch marks, with an extra 0.60 inches at each end. The bars were then tested while immersed in liquid air, at minus 182 degrees C.

"The results show that with the exception of the nickel-manganese-iron alloys, the effect of liquid-air temperature is to increase in a remarkable degree the maximum tenacity of iron alloys, while in most cases their ductility disappears. These changes take place in the softest wrought iron as well as in the various carbon and other steels. In the case of the nickel-manganese-iron alloys, not only, however, is the ductility increased, but the tenacity reaches the high figure of 85 tons with an elongation of no less than 67½ per cent. Further, there is no doubt that the useful toughening effect of nickel upon iron is shown by this research, as even though ordinary nickel steel becomes brittle, it does so to a much less extent than carbon steel. It would appear, therefore, that iron, a cheap and convenient metal itself, must be permeated or alloyed in the mass with some alloy to modify its properties."

In this day of large grate areas, which are responsible for the introduction of new types of motive power and have also prac-

tically measured the limit of endurance of the man behind the scoop, the problem of hand firing of the locomotive has presented food for some good, hard mental work in connection with the scientific phase of the subject, by which is meant the method of firing by small increments and often, or what is understood as the single-scoop system. At the time of the fireman, by the old method, has been divided between opening and closing the fire door, and getting the coal on the grate, it follows that any device that will relieve him of attention to the fire door, and allows him to devote his undivided time to the scoop part of his duties, will necessarily aid him in better firing and with less exertion, to the extent of the amount of time and labor saved at the door.

To accomplish this purpose is the province of the Brewer pneumatic fire door opener of the Franklin Railway Supply Company, Franklin, Pa. This door is operated by compressed air, and is opened simply by the fireman placing his foot on the treadle, which performs the double function of admitting air to the cylinder and raising the door latch, when ready to put in a fire. By this operation the door is opened wide, and by releasing the treadle the door is instantly closed. These functions are performed automatically, noiselessly and with absolute certainty, and also with less detriment to the firebox and tubes by the lesser admission of cold air, since the door is freed from the "personal equation" of a tried fireman. Very extensive use of this door has shown an economy in fuel, as well as decreased maintenance cost of firebox, tubes and staybolts, three of the most important items in locomotive expense account, and all due to the fact that cold air admission is reduced to a point impossible to attain by hand manipulation of the door—*The Railway and Engineering Review.*

For nearly six years the excellent stock companies maintained by Mr. F. F. Proctor at his three New York theatres and handsome playhouse in Albany have been steadily increasing their clientele. In summer or winter alike, the productions have been scrupulously given, and the high standard of the acting has never varied. The present summer, however, promises to witness better results than heretofore. Not only are the plays selected of a better artistic grade, but the personel of the stock company has been strengthened. Better than all, the Proctor theatres are kept wonderfully cool during these warm days and nights. Broad palm leaf fans are distributed to each auditor, while the means of artificial ventilation are admirable in all of the theatres.

A discussion of "The Future of Poland," by David Bell Macgowan, is announced for the July *Century*. While this article was written, of course, before the Czar's issue of the rescript removing many of the restrictive ordinances from which Poland has suffered, such action adds interest and value to this authoritative statement of the oppressive conditions in Poland.

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U. S. PATENTS GRANTED MAY, 1905.

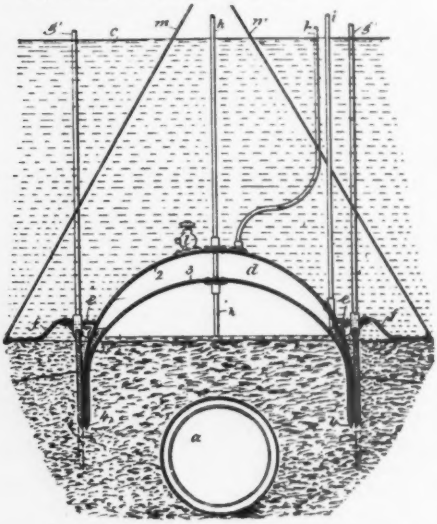
Specially prepared for COMPRESSED AIR.

788,536. PNEUMATIC RAILWAY SIGNALING SYSTEM AND ELECTROPNEUMATIC VALVE THEREFOR. Ernest C. Irving, Westminster, England, assignor of one-half to John Patrick O'Donnell, Westminster, England. Filed Mar. 14, 1903. Serial No. 147,856.

788,546. COMBINED SMELTING AND REFINING FURNACE. Chauncey C. Medbery, New York, N. Y. Filed May 2, 1904. Serial No. 205,893.

The combination with a heating-chamber, of a saddle-frame provided with trunnions and having end guiding and supporting rollers between which the heating-chamber is held and adapted to be rotated; standard-supports in which the trunnions have their bearings; controlling-gear connected to one of the trunnions and by which the heating-chamber may be tilted; a fuel-supply device comprising compressed air and fuel nozzles arranged to supply fuel to the chamber at one end thereof; and slip joints in line with the axis of the trunnions connecting the fuel-supply device with the sources of air and fuel supplies.

788,611. OVERHEAD SHIELD FOR TUNNELING. Roy Stone, New York, N. Y. Filed May 8, 1903. Serial No. 156,154.

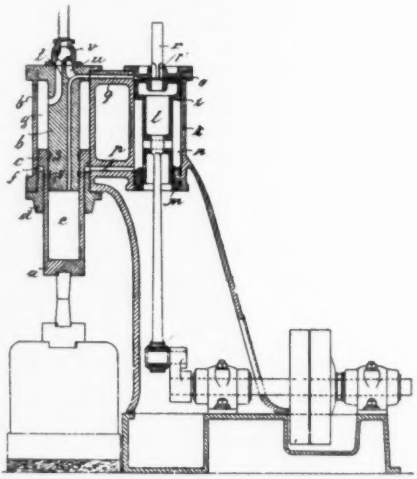


A device for assisting the operation of tunneling, especially through the bed of a body of water, comprising a dome or crescent-shaped structure in cross-section composed of metal plates and hollow, and having an all-around downwardly-extending penetrating edge adapted to sink into the soft material at the bottom of the body of water, means for raising and lowering the same, an all-around series of metal piles lying closely adjacent to the sides of the shield, means for lowering and raising the said piles, a marginal platform connected to the shield structure, a flexible curtain connected thereto and extending outwardly therefrom, means for pumping the water out from beneath the hollow crescent-shaped shield, means for admitting water within the shield to fill the same and add to its weight, and means for pumping the water out of the shield and permitting the same to be replaced by the air.

788,765. PNEUMATIC TIRE. Charles S. Frank, Epworth, Iowa. Filed Sept. 26, 1904. Serial No. 225,983.

788,777. PNEUMATIC UNIVERSAL WIND-CHEST WITH INDIVIDUALLY-OPERATIVE VALVES. August Klann, Pomeroy, Ohio. Filed Nov. 16, 1904. Serial No. 233,009.

788,876. PNEUMATIC HAMMER. Jean Beché, Hückeswagen, Germany. Filed May 13, 1903. Serial No. 156,940.



In pneumatic hammers, the combination of a working cylinder *k*, piston *l*, and a striking-block cylinder *b'* with a striking-block consisting of a cylinder *a*, an annular flange *c* provided at the upper edge of the cylinder *a*, said annular flange

being fitted into the striking-block cylinder b', a fixed plunger fitted into the cylinder a and rigidly fixed to the striking-block cylinder b', channels for guiding the air from the working cylinder to the striking-block cylinder and from the striking-block cylinder to the outer atmosphere, a valve for controlling the latter channel, substantially as described and for the purpose set forth.

788,983. ARMOR FOR PNEUMATIC TIRES. Robert Wright, Cleveland, Ohio. Filed Sept. 24, 1904. Serial No. 225,815.

788,985. AIR-BRAKE SYSTEM. David K. Youtz, McKees Rocks, Pa. Filed Oct. 5, 1904. Serial No. 227,230.

789,029. PNEUMATIC-MUSICAL-INSTRUMENT PLAYER. Lawrence U. Jobes, Cincinnati, Ohio, assignor to The Baldwin Company, Cincinnati, Ohio. Filed Feb. 24, 1905. Serial No. 247,088.

789,081. AIR-BRAKE APPARATUS. Frank S. Cravens, Lexington, Ky. Filed Mar. 22, 1904. Serial No. 199,373.

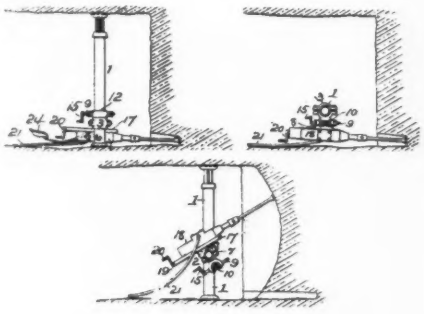
789,110. AIROMETER. Governor D. Warren, Denver, Colo. Filed June 13, 1904. Serial No. 212,299.

An airometer, the combination with a suitable casing, of a shaft located therein and suitably journaled, a number of separated chambers, fans located in the respective chambers and made fast to the shaft, disks or partitions separating the fan-chambers and provided with orifices inclined to the axis of the shaft, spacing-rings surrounding the fan-chambers and separating the partitions, a stop at one end of the casing, an adjustable plug inserted in the opposite end of the casing whereby the partitions and spacing-rings are held in the assembled relation, the casing being provided with suitable inlet and outlet openings, a register, and a suitable connection between the register and the fan-shaft.

789,206. HOIST. Rudolph Conrader, Erie, Pa. Filed Mar. 16, 1901. Serial No. 51,546.

A hoist, the combination of a lifting means; means for supplying fluid-pressure to said means; means for confining the entire exhaust fluid from the lifting side of the hoist to exert a counter-pressure against the lifting pressure during a lowering movement; and a valve mechanism for controlling the supply fluid and the passage of fluid from the lifting to the counter-pressure side of the hoist, said valve mechanism being arranged to cut off the supply while connecting the lifting and counter-pressure sides of the hoist and for maintaining the connection between the lifting and counter-pressure sides of the hoist during the entire lowering movement.

789,703. ATTACHMENT FOR DRILLS. Thomas E. Adams, Cleveland, Ohio, assignor to The Adams Drill Company, Cleveland, Ohio, a Corporation of Ohio. Filed Feb. 6, 1904. Serial No. 192,407.



A drill attachment, comprising a sleeve to be mounted on a column, an arm projecting at right angles to said sleeve, a drill-support on said arm, a bracket on said drill-support, a worm mounted in said bracket, a segmental gear and a clamp for attaching said gear to either the column or arm and in mesh with the worm.

789,744. PNEUMATIC SHEET-FEEDING APPARATUS. George F. Leiger, Chicago, Ill., assignor, by mesne assignments, to The L. Benedict Company, Chicago, Ill., a Corporation of Illinois. Filed Feb. 20, 1904. Serial No. 194,620.

789,745. AUTOMATIC STOPPING DEVICE FOR SHEET-FEEDING MACHINES. George F. Leiger, Chicago, Ill., assignor, by mesne assignments, to The L. Benedict Company, Chicago, Ill., a Corporation of Illinois. Filed Oct. 28, 1904. Serial No. 230,365.

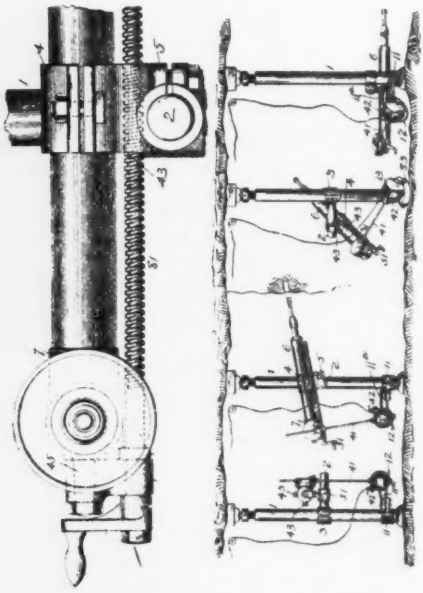
789,746. PNEUMATIC SHEET-FEEDING APPARATUS. George F. Leiger, Chicago, Ill., assignor, by mesne assignments, to The L. Benedict Company, Chicago, Ill., a Corporation of Illinois. Original application filed Feb. 20, 1904. Serial No. 194,620. Divided and this application filed Oct. 28, 1904. Serial No. 230,366.

789,799. PNEUMATIC-DESPATCH-TUBE SYSTEM. William H. Dinspel and Joseph J. Stoetzel, Chicago, Ill., assignors to The Universal Pneumatic Transmission Company, Chicago, Ill., a Corporation of Maine. Filed Aug. 15, 1902. Renewed Apr. 1, 1904. Serial No. 201,118.

789,888. PNEUMATIC-DESPATCH-TUBE SYSTEM. Kenneth E. Stuart, Philadelphia, Pa. Filed Feb. 10, 1904. Serial No. 192,904.

789,951. ROCK-DRILL. Thomas E. Adams, Cleveland, Ohio, assignor to The Adams Drill Company, Cleveland, Ohio, a Corporation of Ohio. Filed Dec. 4, 1901. Serial No. 84,699.

A rock-drill, comprising a pivotally-mounted, longitudinally-movable drill-body, a drill-rod and operating mechanism for the drill-rod carried by the drill-body, a motor independent of the drill-body, mounted to rock, and a rigid drive-rod extending from said motor to said operating mechanism.



A drill, the combination with a drill-body, a drill-operating shaft and a driving-shaft, of a balance-wheel having a recess, a flange on the drill-operating rod and entering the recess in the balance-wheel, fiber rings bearing against the respective faces of said flange, a yielding ring bearing against one of said fiber rings, a nut securing said parts in place, a gear-wheel secured to the balance-wheel and a pinion on the driving-shaft and meshing with the gear-wheel.

789,986. PNEUMATIC-TIRE SHIELD. Joseph Marsden, San Francisco, Cal. Filed Jan. 6, 1905. Serial No. 239,879.

790,046. SUBMARINE CAISSON AND TUNNEL CONSTRUCTION. Peter J. Gildea, San Francisco, Cal. Filed Aug. 26, 1904. Serial No. 222,269.

A caisson comprising inner and outer shells with intermediate air and ballast compartments, a superstructure and a platform located above the surface of the water, with means for entering and leaving the caisson, a supplemental tube leading from the platform to the interior of the caisson, said tube having the lower end turned into a horizontal position serving for the introduction and reception of articles, and air-tight caps fitted upon the top and the inner end of the tube as described.

790,102. AUTOMATIC SETTER FOR AIR-BRAKES. William H. Brooks, Westpoint, N. Y. Filed Nov. 7, 1904. Serial No. 231,655.

790,144. AIR-BRAKE LOCK. Davis L. Mabry, Blossom, Tex. Filed Aug. 26, 1904. Serial No. 222,246.

790,279. PNEUMATIC TIRE. Richard Bellingham and James Bloomfield, Beccles, England. Filed Apr. 18, 1904. Serial No. 203,689.

790,305. FLUID-PRESSURE BRAKE. Harry R. Mason, Chicago, Ill., assignor to The Westinghouse Air Brake Company, Pittsburg, Pa., a Corporation of Pennsylvania. Filed Aug. 19, 1903. Serial No. 170,038.

790,330. CORE-DRILL. Coleman A. Terry, New York, N. Y., assignor to Davis Calyx Drill Company, New York, N. Y., a Corporation of West Virginia. Filed June 10, 1904. Serial No. 211,944.

790,331. CORE-DRILL APPARATUS. Coleman A. Terry, New York, N. Y., assignor to Davis Calyx Drill Company, New York, N. Y., a Corporation of West Virginia. Filed Aug. 25, 1904. Serial No. 222,055.

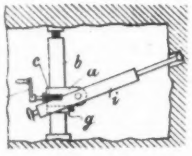
790,417. PNEUMATIC SEPARATOR. Dow L. Adelsperger, Springfield, Ohio, assignor to The Foos Manufacturing Company, Springfield, Ohio. Filed Apr. 9, 1903. Serial No. 151,743.

A separator, the combination, with an outer casing in the form of a substantially cylindric drum having a lateral receiving-mouth and separate outlets in its lower part for the separated materials, the outlet for the heavy material being below the receiving-mouth, of a similar inner fan-casing wholly inclosed within the outer casing, the discharge-mouth of said fan-casing being located above the heavy-material outlet and directed upward toward the receiving-mouth, a blast-fan mounted within the fan-casing, and a separating-plate located in the space between the two casings, connected with the fan-casing above the receiving-mouth, diverging from said casing to form outgoing and return passages and extending over the top of the fan-casing, terminating at a point in the rear thereof and above the other outlet of the main casing, the outgoing-passage between the separating-plate and main casing being connected with the fan-outlet, and the return-passage on the other side of the separating-plate being connected with the fan-inlet, substantially as described.

790,456. PNEUMATIC-DESPATCH-TUBE APPARATUS. Otto S. Pike, Malden, Mass., assignor to American Pneumatic Service Company, Dover, Del., a Corporation of Delaware. Filed Feb. 12, 1904. Serial No. 193,233.

790,457. PNEUMATIC-DESPATCH-TUBE APPARATUS. Otto S. Pike, Malden, Mass., assignor to American Pneumatic Service Company, Dover, Del., a Corporation of Delaware. Filed Feb. 12, 1904. Serial No. 193,234.

790,506. ROCK-DRILL MOUNT. Mathias Kuzel, Penzberg, Germany. Filed Oct. 10, 1904. Serial No. 227,864.

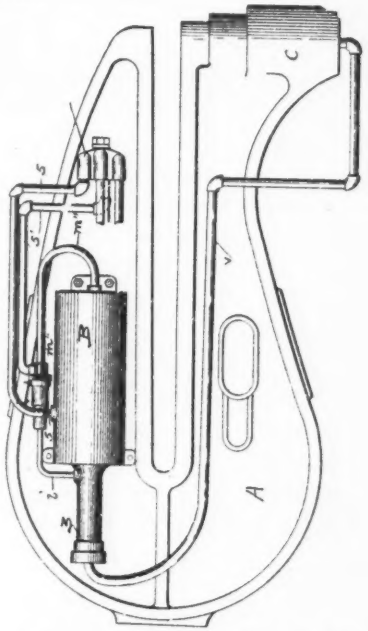


A drill-mount, the combination, with a standard, a sleeve adjustable vertically thereon, a worm-wheel adjustable on the standard by means of a spline and groove, and a worm carried by the sleeve and engaging with the worm-wheel, of a drill mounted on the sleeve at a point substantially within a horizontal plane embracing the worm and worm-wheel and passing through the transverse axis of the sleeve.

790,476. PNEUMATIC SPRING. Bruce Borland, Chicago, Ill. Filed Oct. 17, 1904. Serial No. 228,752.

A device of the class described, the combination with a fluid-chamber having a freely-movable reciprocating piston located therein, means for conducting fluid to and from the fluid-chamber at opposite sides of the piston, an air-chamber communicating with the fluid-chamber, and an auxiliary passage in communication with the fluid-chamber and provided with a normally closed valve automatically opened upon the movement of the piston in one direction only.

791,075. PNEUMATIC ATTACHMENT FOR RIVETING AND PLATE-CLOSING MACHINES. Henry A. Carpenter, Sewickley, Pa., assignor to Riter-Conley Manufacturing Company, Jersey City, N. J., a Corporation of New Jersey. Filed Apr. 9, 1902. Serial No. 677,107.



A pneumatic attachment for riveting and plate-closing machines, the combination of a pneumatic cylinder, a hydraulic cylinder, a piston in the hylraulic cylinder adapted to act initially on the fluid, a piston and piston-rod in the pneumatic cylinder adapted to act secondarily on the fluid, and a valve controlling the air-pressure to the pneumatic cylinder which is automatically actuated by the initial compression of the fluid in the hydraulic cylinder to supply the requisite air-pressure to the pneumatic cylinder.

790,808. AIR-BRAKE SYSTEM. James E. Shaw, Council Grove, Kans. Filed June 21, 1904. Serial No. 213,452.

790,953. AUTOMATIC AIR-BRAKE AND CAR-COUPLING COMBINED. Lewis C. Cary, Chicago, Ill., assignor of one-half to Everett E. Swiney, Chicago, Ill. Filed Jan. 9, 1904. Renewed Jan. 23, 1905. Serial No. 242,326.

791,110. AIR-BRAKE PIPE-COUPLING. John H. Phillips, Pottsville, Pa. Filed Mar. 1, 1905. Serial No. 247,957.

791,176. SAND-BLAST REGULATOR. Fred. W. Breidster, Milwaukee, Wis., assignor to Joseph Shaver, Milwaukee, Wis. Filed Sept. 16, 1903. Serial No. 173,401.

791,264. BIT FOR ROCK-DRILLS. Martin Hardsocg, Ottumwa, Iowa. Filed May 23, 1904. Serial No. 209,531.

In combination with a bit provided with a longitudinally-extending passage on its interior opening through the cutting-face, a socket provided with a shank adapted for insertion into a pneumatic tool, said shank being provided with a longitudinally-extending passage adapted to communicate with the passage in the bit, and a series of radially-arranged vent-openings for discharging the excess of exhaust-air, substantially as described.

791,324. AIR-BRAKE APPARATUS. Augustus B. Currier, Battlecreek, Mich. Filed July 9, 1904. Serial No. 215,919.

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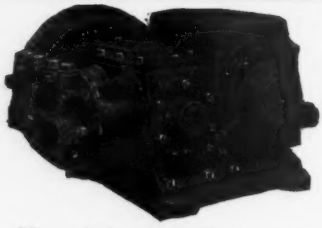

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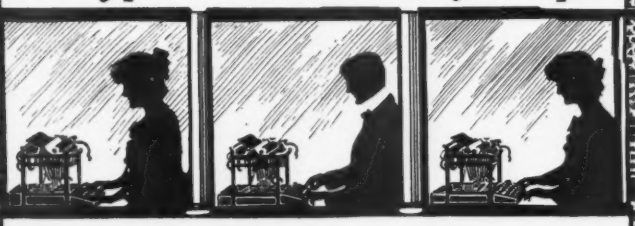

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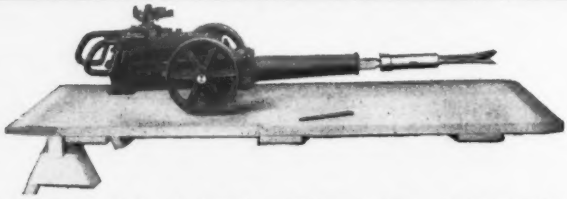

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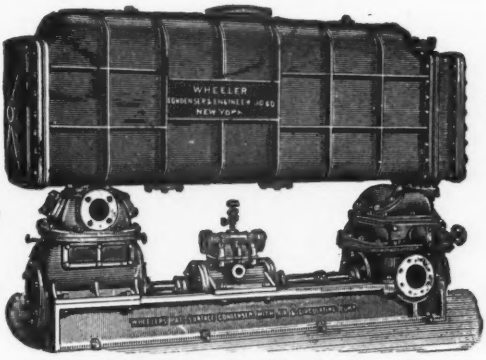

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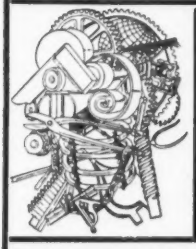

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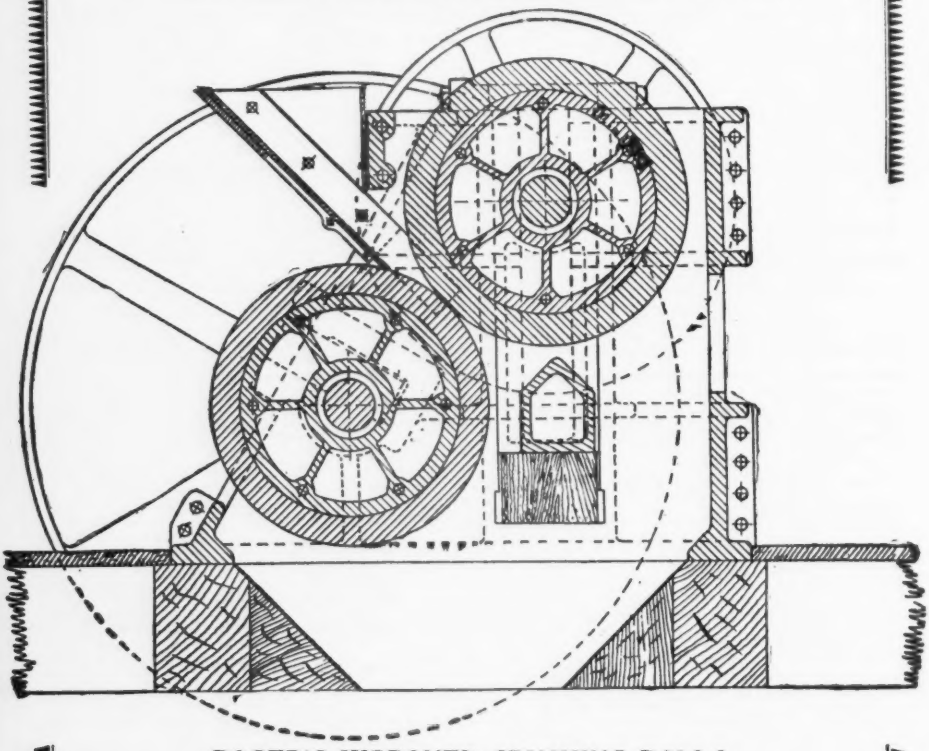

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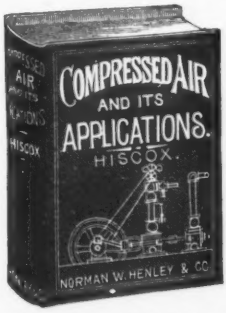

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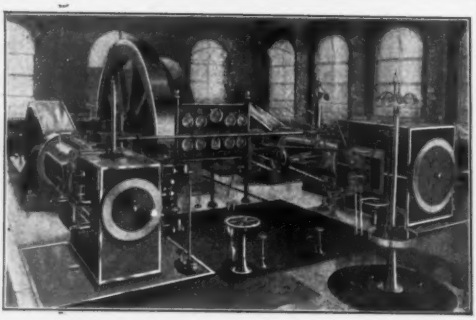

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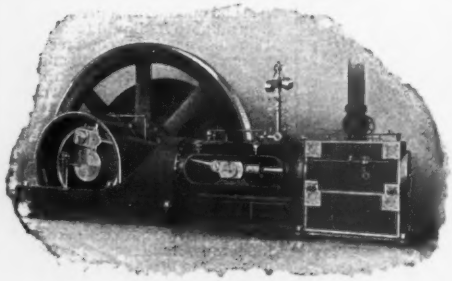

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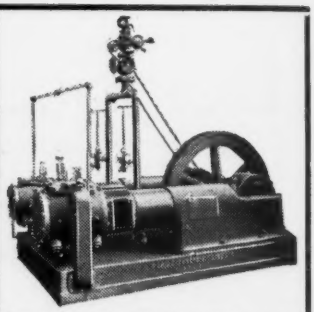

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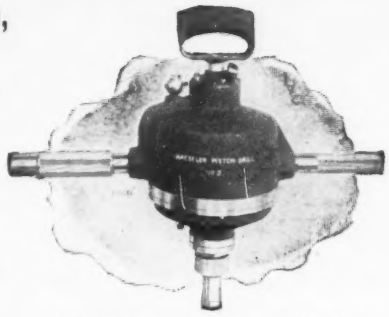

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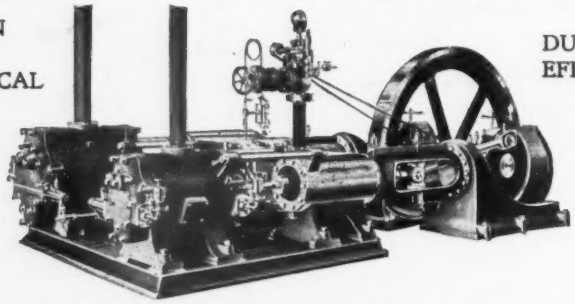

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